THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY.

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXVII.—No. 5. Whole No. 437 | NEW YORK, MONDAY, SEPTEMBER 3, 1877 | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

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☞ An asterisk (*) denotes an illustrated article

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FIFTH ANNUAL MEETING OF THE AMER. GAS LIGHT ASSOCIATION.

The fifth annual meetinng of the Association will be held at Cincinnati, O., on Wednesday, Oct. 17, 1877. Headquarters will be at the Gibson House on Walnut St. between 4th & 5th where arrangements have been made for the members at special reduced rates per day.

The meetings will be held in Gas Hall, corner of 4th and Plum Sts. Members are requested to prepare papers on any subject connected with gas matters, and to confer with the Secretary concerning the same. CHAS. NETTLETON, Sec'y.,
117 Broadway, New York.

As will be seen by the above notice the necessary arrangements for the 5th Annual Meeting of the American Association are progressing. Headquarters will be at the Gibson House, and the sessions will be held at the Hall of the Cincinnati Gas Company.

All the local arrangements are committed to the care of General Hickenlooper, the President of the Cincinnati Gas-Light Company, and the announcement of this fact is sufficient to warrant the conclusion that every thing will be well and amply provided for, to secure to those who assemble there every comfort for a profitable and enjoyable time.

It is intended to devote one half day to visiting points of interest about the city, after having visited the works of the Cincinnati Company. To those of our Eastern friends who have never visited the West, we would especially appeal to avail themselves of this occasion to go. While all those who have in times past enjoyed the pleasure of a Western trip will doubtless so make their arrangements for the middle of October as to repeat the visit. It is especially desirable that this should be a *full* meeting, as matters of importance are to be discussed, and it is proper that the gas interest should be well and fully represented; and here we would say one word very plainly, viz.—*each gas company should pay the expenses of their engineer, superintendent, or other representative in attending these meetings.* We know the times are hard, and stern economy is being practiced, of necessity, by many companies. But we would impress it upon the minds of Boards of Directors that there is no truer economy than having their agents posted in their business; and the value of these meetings, when conducted on the true basis, is incalculable. Here the managers of different works meet together, and, aside from all the facts set forth in in the papers and discussions, the information obtained personally by conversation with each other, is of the greatest value. Many managers are not liberally paid, and can ill afford the expense of a trip of this kind; but more than all this—the benefit of the meetings goes directly to the companies whose agents attend them, and the information acquired is not the personal property of the employee, but goes at once to increase his value as a servant of the company, and the *small outlay required on the part of the company is amply repaid thereby*, and no gas company that expects to hold its own in the progress of the age in the science of gas making can afford to be unrepresented at these meetings. It is money in the companies treasuries to send their representatives, as has been proved in repeated instances by those who have attended. Many engineers and superintendents have told us that the information obtained from a single paper had saved thousands of dollars to their companies.

True economy is never niggardly, and "the penny wise" policy is always sure to prove itself one that is "pound foolish." Arrangements are being made to obtain tickets at reduced rates, and those going from the East can make their arrangements to leave New York, on Monday evening, Oct. 15, at 6 P. M., and go together, arriving in Cincinnati at 8 P. M. of the following day. The Secretary of the Association will inform the members of these arrangements as soon as they are definitely settled.

THE SEMI-ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

This meeting was held at Portsmouth New Hampshire, at the Rockingham House, on the 15th and 16th of last month. The design of these semi-annuals is to make them social and informal in character rather than strictly business and professional. Something like fifty members were present, and on the first day the Society was called to order promptly at 12 M., by the President, Mr. Samuel G. Stiness, of Rhode Island. After the roll call, and the regular routine action upon the unfinished business, a short address was delivered by the President congratulating the members present upon the success of the Society thus far, and referring in general terms to the condition of the great interest which its members represent.

A fitting allusion was made to the death of

two members since the last meeting. viz., Mr. Harriman and Mr. Perry, and, subsequently, a committee was appointed to draft proper resolutions relating thereto. The meeting was then opened for general discussion, and informal conversation, on such topics as presented themselves in which many of those present took part, either by asking questions, or stating some practical fact that had come under their personal observation. Among other topics, that of Sunday labor was quite freely discussed, and it was quite surprising to find how general the interest seemed to be in this matter. Many facts were stated by those who had made, and were continuing to make, such arrangement of their work as to almost entirely suspend labor on Sunday, which seemed most conclusively to prove that the thing was possible; and, not only that, but profitable. Some works where this is being done were works of considerable magnitude, and the arrangement had been found to work well. A second meeting of similar character was held in the evening, and almost every topic connected with practical management was talked over.

On the second day an excursion was made to the Isles of Shoals, and afterwards, the day being fine, the party proceeded outside to try their hand at fishing. The first efforts in this direction were to secure some sword fish. Many of them were seen, but none taken. A special "harpoonist" had been employed for the occasion, and although he showed great skill in throwing his harpoon, the fish showed still greater in avoiding it.

The explanation of this was that the harpooner was unaccustomed to going for sword fish with steam, and the rapid motion of the boat made it almost impossible to take the fish.

The assistant "hapoonist," whose manly form was lashed to the jib stay, would undoubtedly have been able to secure a large fish, had not his well-known modesty and bashfulness prevented his throwing his lance until after the harpooner-in-chief had tried his hand, and by that time it invariably proved that it was too late.

After having had much sport, of an exciting nature, in going after the sword fish, the party returned to the fishing grounds, and contented themselves with pulling in a variety of smaller fish. A pool was made up for the first cod or haddock which was secured by one of the members of the Society, who caught a "Tom-cod" weighing about three-quarters of a pound.

After returning to the Rockingham the party partook of a most excellent dinner, prepared by the host, after which the usual speechmaking, toasts, etc., followed. A more delightful place, or a more attentive landlord could not be found than is afforded at the Rockingham House. Most of the party remained till next morning, when they parted with regret.

La Hoo!

[Communicated.]

The Electric Light.

It is decidedly refreshing this warm weather to read a book so carefully written, beautifully printed and illustrated, as that of M. Hippolyte Fontaine, upon Eclairage a l'Electricite Renseignments Pratiques.

The literary critic of *Engineering*, in the issue of July 6th, 1877, writes as follows about the work and its author—

"M. Fontaine, the author of this work, has devoted many years to the development and introduction of the Gramme machine, so well known as a powerful means of producing the electric light, and largely employed for that and other purposes.

* * * *

In this book he has contributed the most valuable addition to our practical knowledge of the subject, and, although he, in a preface, gives a long list of other authors from whom he has derived much information, he is none the less deserving of much praise, and thanks, for the excellent manner in which he has performed his work.

It is refreshing to any one interested in the manufacture of gas to read about, and investigate any methods, no matter how formidable they may be to existing interests, that are devised for cheapening the production of light, provided said methods, or processes, have been devised by learned men supported by others of character, reputation, and intelligence, understanding the problems to be solved.

It is far otherwise when one is compelled to investigate worthless processes, invented (?) by ignorant men, and pushed upon the public by mountebanks and unprincipled adventurers. Your readers have, probably, read the result of the investigations, reported in the *Journal of Gas Lighting*, of the electric candle, and it is not necessary to enter upon the subject here. I have thought, however, that the conclusions of so great an authority as M. Fontaine, upon these most important matters, might be of interest to those of your readers who have not seen his work, and I have, in consequence, translated certain portions from his last chapter, that may be termed his conclusions upon the essential point, to us, of the electric light, *i. e.*, its divisibility.

In chapter X, M. Fontaine gives the cost of producing the electric light, and he estimates that, under the most unfavorable circumstances, to produce a light of equal intensity, with gas at $1.80 cents per thousand, it would cost eleven times more than if the light was produced by the Gramme machine, and, under favorable circumstances, forty times more. Ought not these figures, whether we accept them or not, to urge us strenuously to endeavor to improve our methods so as to cheapen the production of our gas, and, by every means possible, to increase its consumption?

Yours, with respect,

Newark, Augst 27, 1877. V.

Divisibility of the Electric Light.

Shall it be said that the divisibility of the electric light will never be realized, and that it is necessary to renounce forever the sight of electricity replacing gas in its many applications? No, a hundred times no. Science is far from having said its last word upon the transformation of this mysterious fluid that has already overcome space, and which can, at a moment's notice, overcome the night; only let us look at the matter practically. Notwithstanding the many and strained editorial anouncements recently made in Russia, notwithstanding the remarkable achievements of M. Jablochoff, and the not less remarkable experiments of M. Denayrouse, there does not exist today, May 1st, 1877, anything that admits of an easy application, anything that one could recommend for a provisional trial, and, *a fortiori*, for a permanent installation.

Every ten years a new idea arises, the hundred voices of Rumor carry it to the clouds, then, after unfortunate trials, Silence establishes herself little by little. In 1847 was announced the discovery that King had made, in England, of the incandescent carbon points; in 1857, M. de Changy, in Belgium, replaced the carbon by platinum, and combined a current regulator; in 1867, M. Leroux, in France, made known a method to make the same current pass alternately, and very rapidly, in several ordinary regulators: at last, in 1877, M. Jablochoff, a Russian officer, passed the electric spark upon a plate of kaolin, and obtained a series of small lights.

We believe that for a complete success to crown these so great efforts, it will be necessary to discover a new source of electricity, or to find a means of practically utilizing atmospheric electricity. To avoid the onerous experiments and frequent illusions it will suffice to comprehend the mechanical equivalent of light as we know that of heat. Each one of the proposed systems has something of good in it, very much of good, and, without any doubt, it is susceptible to do important work in special cases; the mistake of the inventor is the great desire to generalize too much about the employment of their apparatus, and to talk about suppressing lighting by gas. Certainly electricity has already an immense field for exploitation, and chapter 7 and 8 should convince the reader of the great advantages it presents in a great many applications, but that it will entirely take the place occupied by gas, is so very far in the future, most probably, that it will never be reached.

We have never so much admired the facility of the employment, the simplicity of the introduction, the indefinite divisibility, and the multiplicity of the uses of gas, as since we have been occupied in lighting by electricity. We do not call the production of several intense jets with the same machine or with the same voltaic pile, the divisibility of the electric light; there is no question about the production of small jets of from 1 to 15 Carcel jets. It is undeniable that we can put in action several lamps by the same electro-magnetic machine, the great question is to know if the single apparatus does not cost more for the first cost and to put in action, than a series of small machines each feeding a lamp.

It being well understood that the divisibility of the electric light is, practically, not to be realized, at least for the present, and with the means proposed up to this day, we will pass to consider the principal inventions for the solution of the problem. He concludes his book as follows:

M. Jablochoff has had the idea of introducing into the central circuit of an electro-magnetic machine, the interior thread of a series of spools of induction, and to pass the induction-spark upon a plate of kaolin, placed simply between the two extremities of the exterior thread of each spool. The plate of kaolin interposed is heated, reddens, and becomes luminous. The current passes first upon a priming of a better conductor, placed upon the sides of the plate of kaolin. By this means M. Jablochoff hopes, in the future, to produce 50 luminous jets, with the same electro-magnetic machine; so hoped, also, Messrs. King, Lodyguin, Koun, Kosloff and de Changy. May M. Jablochoff be more fortunate than his predecessors. We wish him success with our whole heart.

Cantor Lectures.

The Chemistry of Gas Manufacture.

By A. Vernon Harcourt, Esq., M.A., F.R.S.

Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

[From the London Journal of the Society of Arts.

Lecture III.—Monday, March 19.

The substances which we have considered hitherto have been those removed from coal gas in

the processes of purification and condensation. Means have been found in the manufacture of coal gas for retaining these substances which are valuable in giving light or heat, and removing those which either diminish the power which the gas has of giving light, or are in other ways injurious. I spoke in my last lecture of the two alternative materials employed for the removal of sulphuretted hydrogen. This diagram represents an iron box with two layers of oxide of iron through which the gas passes; and either by this material or by lime, sulphuretted hydrogen is wholly removed from the gas. There is another ingredient always present in the crude gas, which is more or less completely removed by purification—namely, carbonic acid.

The table to the right gives the results of some analyses made by Dr. Frankland, of the composition of gas as it is supplied to the consumer. The constituents of the gas are here divided into what are termed illuminating hydrocarbons, of which ethylene or olefiant gas is the principal; marsh gas and hydrogen, which together form, by volume, much the largest part; carbonic oxide, which comes third in order of quantity; and, besides these, in small proportions, carbonic acid, nitrogen and oxygen. I propose, in my next lecture, to speak of these constituents of coal gas which are the more important for the purposes for which we use it; and, in the present one, to direct your attention to this substance (carbonic acid), and to another chemically resembling it, in which the carbon is combined, not with two atoms of oxygen, but with two atoms of sulphur—namely, carbon bisulphide.

I will show you, in the first place, a familiar experiment, to illustrate the formation and properties of carbonic acid. When a piece of charcoal is heated in the air, we all know that it burns, but not very readily. that, in fact, many pieces must be placed together, in order, by the exchange of heat between them, to maintain a sufficient temperature for their combustion with the oxygen of the air. But if I take, instead of air, a bottle of oxygen, and transfer the piece of charcoal, which is still alight, to the oxygen, you see the brilliant combustion which takes place. That combustion consists in the union of the carbon and the oxygen the two substances which the bottle contains. They combine directly together, forming carbonic acid, or carbon dioxide.

I will allow the carbon to burn, and I will show you the properties of the gas which is formed, using another bottle which has been previously filled with it. Observe, first, the property which carbonic acid has of extinguishing flame. A lighted taper lowered into the bottle is extinguished. This, of course, is a negative property, and shows only that carbonic acid is not air or oxygen, and will not do what air or oxygen will do, namely, combine with the carbon and hydrogen of the taper producing light and heat. Another property of the gas is its high specific gravity as compared with air. If I take this bottle of carbonic acid and pour it into what we call an empty bottle—that is, a bottle filled with air, we shall, owing to the difference of specific gravity between them, obtain an exchange of their contents. The difference is not like that between water and air; the gas pours rather slowly, but probably I have now effected a transference. The uppermost bottle has lost its carbonic acid, and becomes filled with air, as you see from the way in which the taper burns in it. The lower bottle has been filled with carbonic acid, as you see from the extinction of the taper.

Another property of carbonic acid is the power which it has of uniting with lime. I have here a solution of lime in water. If I take this solution, which is now perfectly clear, so that it looks like pure water, and pour it into the bottle of carbonic acid, and bring it into contact with the gas by shaking the bottle, you see the milkiness which is produced. This illustrates a chemical change which occurs in the manufacture of coal gas. It is on the affinity between carbonic acid and lime manifested by the precipitation of the lime in this experiment that the purification of coal gas from carbonic acid by the action of lime depends.

The formation of carbonic acid in the manufacture of coal gas is probably due to a very small extent, if at all, to the direct action of the air upon the carbon of the coal. Such action can only happen where the exhaustion—as the pumping of the gas out of the retorts is called—is carried too far, so that the pressure in the retorts is less than the atmospheric pressure. In this case some of the air or furnace gas, from outside, would enter through the pores or cracks in the clay retorts, and become mixed with the gas. The small percentage of nitrogen which is usually found when coal gas is analyzed, and the further fact the nitrogen is generally accompanied by oxygen, show that this over-exhaustion is not a common occurrence. The main source of carbonic acid, no doubt, is a reaction between the water, which the coal placed in the retorts contains, and the heated carbon. In the manufacture of what is called water-gas—that is, gas produced by the action of steam upon red hot coke—there are formed three gases, hydrogen, carbonic oxide, and carbonic acid, the proportion between them depending on the temperature at which the coke is maintained. The same reaction happens to some extent in the gas retort in the manufacture of coal gas. There is always water in the coal, and as the outer part of the charge lying next to the heated sides of the retort becomes red-hot before the water is wholly expelled from the interior of the charge, this same action of steam upon heated coke takes place, and one of the products is carbonic acid.

For the removal of the carbonic acid, purification by lime is perfectly sufficient, if only the lime is applied in sufficient quantity, and renewed sufficiently often. The presence of carbonic acid in the gas is no injury to the consumer, provided the gas supplied is of sufficiently high illuminating power; that is to say, provided the illuminating power of the gas is fixed, it matters nothing to the consumer whether he is supplied with a gas which is somewhat richer, and whose illuminating power is to some extent diminished by the presence of carbonic acid, or with a gas otherwise poorer, but free from carbonic acid. Although this substance is injurious when present in any large proportion in the air, yet no objection to the presence of carbonic acid in coal gas can reasonably be made on this ground, since the quantity of carbonic acid yielded by burning gas is not materially affected by its presence in the unburnt gas. Two of the ingredients of coal gas—marsh gas and carbonic oxide yield their own volume of carbonic acid when they are burnt; and the olefines yield twice, or more than twice, their volume. On the whole, the volume of carbonic acid discharged into a room where gas is burnt is more than it would be if the gas contained 50 per cent. of carbonic acid, the rest being hydrogen. It has, however, been proved that the presence of carbonic acid in coal gas has a decidedly injurious effect upon its illuminating power; and since the formation of carbonic acid cannot practically be avoided, either it must be removed by some subsequent process, or the proportion of illuminating constituents must be increased by mixing with the ordinary coal a larger proportion of the more costly cannel, or by heating the retorts less strongly, which improves the quality at the expense of the quantity of the gas. Therefore, in the interest of the maker of gas, it is desirable to remove carbonic acid. This is accomplished to some extent during the condensation and washing of the gas, the carbonic acid being removed in combination with ammonia, but at present the only mode which is in general use for effecting this object thoroughly is passing the gas through trays or sieves on which damp slaked lime is placed.

I come next to the substance which I spoke of as being chemically analogous to carbonic acid—carbon bisulphide. I have here a little bottle containing a small quantity of this substance. When pure, it is quite colorless, and of an odor which is not unpleasant, resembling the odor of chloroform. Commonly, it is not pure, and has a slightly yellow color, and an unpleasant smell. It is very volatile, having a low boiling point and a high vapor-tension at the ordinary temperature. If I pour a few drops of this liquid into a bottle of air, and cause the vapor to displace and diffuse through the air, by shaking the bottle and at intervals raising the stopper, and then pour the heavy gas out of the bottle into this beaker, leaving any liquid there may be still remaining at the bottom of the bottle, and apply a light to the contents of the beaker, you see the inflammation and gradual combustion of the gaseous carbon bisulphide. This experiment shows, in the first place, that the liquid is very volatile, for it has in a few moments formed sufficient gas to have nearly filled the bottle into which it was dropped; in the next place, that it is heavy, for I poured it quickly through the air, from one vessel into another; in the third place, that it is inflammable–it lights and burns readily. But I might have shown you that it is very much more inflammable than most substances, that is to say, that the temperature required for its inflammation is much lower than the temperature required for the inflammation of coal gas, or of most inflammable substances; for if, instead of applying a taper, I had simply heated a glass rod in the lamp, and dipped that into the beaker, I should have succeeded equally well in lighting the carbon bisulphide. Its presence, even in small quantity, when mixed with hydrogen, imparts this property of ready inflammability to the gas; and just as the vapor of the liquid hydrogen phosphide imparts to hydrogen or other inflammable gas the property of what we term "spontaneous" inflammability—that is, inflammability at the ordinary temperature—so the vapor of carbon bisulphide communicates the property of inflaming at a temperature above the ordinary temperature, but very much below that at which hydrogen would otherwise inflame.

[To be Continued.]

Connellsville Coke.—The coke manufacture o the Youghiogheny Valley is made the subject of a special report recently issued by the Pennsylvania Gealogical Survey. From the figures given it appears that this trade, which, up to the year 1875, covered but a small area of territory, and employed but few ovens and but limited capital, has within the past decade grown into one of the great industries of the western section of the State. From small beginnings in the immediate section of Pittsburgh, the coke interest has spread over about one-third of the entire length of the Youghigheny Valley. The Connellsville coke, under which name the greater part of the product is known, is made of coal obtained from the Pittsburgh coal bed. This latter occupies in the Connellsville basin a trough three miles long, and gives from 8 to 11 feet of easily worked and cheaply mined coal, from which an excellent coke is obtained. In this region there are at present 45 coke works, having 3,578 ovens, which produce when running on full time, on 48 hour coke, a weekly yield of 1,302,600 bushels.

Gas Measurement.

T. O'CONOR SLOANE, A. M., E. M., PH. D.
CHEMIST N. Y. GAS-LIGHT CO.

The referee's form of cubic foot measure if supplied with a proper tank, is unquestionably the most convenient and accurate form of that piece of apparatus. I have frequently had occasion to use one, and have had a light derrick constructed for the purpose of raising and lowering the tank.

The derrick is made of wood, in five pieces—four legs and a top. The top is a block of hard wood, six by four inches in section, and about eighteen inches long. In one of its faces are sunk four holes, one at each corner. They are square and tapering, smaller at their bottoms than elsewhere. The legs are about an inch and a quarter square at their largest section, and taper at the bottom to three quarters of an inch square. They are eight feet long. The upper end is shaped so as to fit the mortices in the head block. The mortices should be about three inches deep, and so inclined, that, when the legs are inserted their lower ends will be the corners of a square of about four feet across.

This forms the derrick, and is amply strong without any further bracing—all the necessary strength is derived from the mortices.

The head contains two grooved wheels set into it, whose plane corresponds to the vertical when all is in position. One is in the middle and the other towards one end—both lie in the axis of the block and consequently in the same line. A ring bolt is fastened to the block, in the same line and at the other end, and projects from the lower side of the block. A piece of smooth rope, preferably sash cord, and one double sheaved pulley, with slings for the tank, completes the essentials.

One end of the rope is fastened to the ring-bolt, hence it passes through one of the sheaves of the pulley, over the centre wheel in the block, through the other sheave of the pulley, over the end wheel in the block, and then down. To secure the end to, a cleat is provided, fastened to one of the legs of the derrick.

The tank is a large galvanized tank, similar to a water cooler. By this arrangement it can, when full of water, be easily raised and lowered by one man—if he be of an industrious temperament, by the experimenter himself.

By a hose of proper length the faucet of the tank is connected with the inlet pipe at the bottom of the cubic foot bottle. This is kept connected as long as the measure is in use. The tank is raised, and the cocks opened to fill it—the tank is lowered to empty it. The water runs in or out of its own accord, and no handling of it is necessary.

The advantages of this arrangement over any other are various. The exterior of the holder is never wet, so there is no lowering of temperature due to evaporation. The water is not disturbed, it runs back quietly into the tank so that no pumping is necessary—this is of importance, as anything of the sort would tend to change its temperature. It is easily managed, as one person can do everything, and is very easily transported. The legs of the derrick can be taken out of the tapering mortices, which are made tapering for this end, and then the whole machine carried to any place where it is proposed to use it.

The referees form of cubic foot measure it is of course quite unnecessary to describe. In conjunction with the derrick described above, it is a most convenient apparatus for testing small meters—photometer or experimental—whose drums have a capacity of a cubic foot, or of an integral part thereof. I will return to this subject later.

It is well to test a cubic foot bottle before using it—not to trust entirely to the maker's certificate. This may be readily done by filling it with distilled water, weighing it before putting it in, and as a check weighing it when running it out. The trouble is to secure the use of a suitable balance. I used one of the large balances (Becker's make) in the Assay Office in Wall street, in this city, for the verification of a cubic foot measure, which is now in the possession of the New York Gas-Light Company.

I took the measure with some ten gallons of fresh distilled water— it should be recently distilled, as it otherwise may have absorbed some oxygen or carbon dioxide from the air, and so have altered its specific gravity—to the Assay Office and set the measure up near the balance I was to employ. To facilitate the introduction of the water the upper glass tube should be removed. Besides the water a large flask of three gallons capacity, an accurate thermometer, a funnel, and some towels must be supplied. This is all the requisite apparatus. I shall now proceed with the account of my operations.

Water was first poured into the bottle until the mark on the lower glass tube was reached. The large flask was filled with distilled water and weighed. The water was poured into the holder, and the flask, with any residual water, again weighed. The difference gave the water which had been poured into the measure. Two or three of these flask-fulls nearly completed the filling. Then the upper glass tube was put in position, and more water weighed, poured in until the mark was reached, and the residue weighed. The sum of the differences gave the total weight of distilled water, which the measure held. A string was then tied to the top of the thermometer and it was lowered into the water in the measure so as to ascertain its temperature. I then checked my result by running it out and re-weighing the water.

I obtained by this process the following figures:

Cubic foot measure. Contents in troy ounces of distilled water.

Temperature.....	60° Fahr.
Water introduced.....	909.615 F. oz.
Water taken out.....	909.505 "
Average weight of water.....	909.560 "

The true weight of a cubic foot of water at this temperature is 908.884 troy ounces. The error, therefore, was equal to 909.560—908.884 or 0.676 troy ounce. The error is less less than one-tenth of one per cent. I corrected it readily by changing the position of the marks on the glass tubes. This last correction I made afterwards with an ordinary balance, dividing the correction between the upper and lower tubes.

The testing of meters or graduated holders with the measure, should be conducted in a room not liable to changes of temperature. The temperatnre of the room is noted, and the tank filled. This by the addition of hot or cold water, is brought to the same degree of heat as that of the air of the room. If only a small meter is to be tested it can then be filled from the water in the tank, as this may always be assumed to hold a little more than is necessary. If this be too great a drain upon it, or if several meters, or a graduated holder are to be tested, a separate quantity of water may be brought to the proper temperature for them.

The object to be tested is levelled, filled, and adjusted, and water run into the measure until the lower mark is reached. Its upper end is connected tightly by a hose, to the inlet of the holder or meter. The tank is hoisted up, and water run in until the upper mark is reached. The rate must, in the case of a meter, be the same as that at which the meter will be run in practice. Thus one cubic foot of air will have passed from the holder, and will give the error of the object tested.

A Sugg Photometer Meter has a drum-capacity of one-twelfth of a cubic foot. Nothing is more accurate or convenient for testing them than a cubic foot measure, arranged and worked as I have described.

Station meters are generally tested by the meter makers, and in a very empirical manner. To do it accurately the temperature and pressure of the gas must both be taken into account.

They are tested by a standard meter. Gas is passed through the standard and station meter, one immediately following the other. Either one may come first.

The standard should be a wet meter and very carefully verified. It should be provided with pressure gauge and water level indicator. The upper end of the indicator should be connected by a piece of tubing with the inlet pipe of the meter. The usual connection with the gas in the meter case should be cut off. Thus arranged it will indicate the level of the water inside of the drum. It should on all meters be thus connected, but it is not generally done.

We will suppose now that the accuracy of the standard meter is known. It is placed in position near the station meter, and connected with the outlet pipe. Its own outlet may lead into the air, or gas mains. Gas is now passed through both in succession. Readings of pressure in both meters, and also of temperature, must be taken at short intervals—index readings should be taken every twenty-five to one hundred cubic feet, according to the drum capacity of the station meter. The passage of gas should be continued until twice the drum contents of the large meter shall have been passed, or what is the same thing, until that drum shall have made two revolutions. Then a comparison of meter readings, after corrections for temperatures, will give the error, if such there be, of the large meter.

The standard meter will generally run so fast that the water in the water level gauge will keep up a continual oscillation. The best that can be done is to average it with the eye. Then water must be at hand so as to always keep the right amount in; if the rate varies a little water may have to be added or removed.

I had occasion to test station meters, which I wished to refer to the cubic foot measure. I adjusted the water line of a Sugg's Experimental Meter with the measure, adding or removing water until it registered nearly correctly. This meter had a drum capacity of one-twelfth of a cubic foot.

The standard meter was placed in its final position near the station meter. The Sugg meter was taken to the same place, and the standard tested with it, until a correct water line was determined. A good practice is to try the small meter immediately before and after this verification of the standard. I give below some of the readings I obtained in testing the standard.

(*a*) Sugg meter registers 99.9 per cent.

Sugg's Reading.	Temp.	Time.	Stand. Reading.	Temp.
961.85	75°	11.08 A.M.	1051	77°
970.90	77°	12 06 A.M.	1060	77½°
* *	*	* * *	* *	*
1026.00	78°	4.02 P.M.	1115	77°

Total amount by Sugg's meter.....	64.15
Total amount by Standard meter.....	64.00
Registry of Sugg's 1-1000.....	64.21

This meter may be considered correct. The average of all the temperatures taken, though nearly the same for each meter, favors a correction which would bring the standard still nearer correctness.

The capacity of the drum of the station meter under trial was one thousand cubic. It is a rule that should always be followed, that a meter is always to be tested by an exact number of revolutions; no partial revolutions are admissible.

Below is a table giving several of the readings obtained in testing the station meter. In this case the gas first passed through the station meter, then through the standard, and then into the air.

Stand. Readings.	Meter Temp.	Time.	Station Readings.	Meter Temp.
00	66°	10.10 A.M.	00	66°
104	—	10.23 A.M.	100	—
*	*	* * *	*	*
1107	64½°	11.32 A.M.	1100	66°
*	*	* * *	*	*
3111½	64°	1.26 P.M.	3100	66½°

Pressure, 2 inches of water. Pressure, 6 inches.

AVERAGE OF READINGS.

Standard Meter, 1107—104.	Av. Temp.	65.1	1003
Station Meter, 1100—100.	"	"	66.4	1000
Standard Meter, 3112—104.	"	"	64.8	3008
Station Meter, 3100—100.	"	"	66.4	3000

Corrected for the difference in temperature and pressure the 1005 foot readings become:

Station Meter, 10104.
Standard Meter, 10066.

Corrected as above the 3000 foot readings become:

Standard Meter, 3021.
Station Meter, 3031.

Taking the standard meter readings as 100 the station meter registration reduces by rule of three to

For the 1004 foot test, 100.38.
For the 3000 foot test, 100.33.

That is to say the meter under trial registers thirty-five hundredths of one per cent. too much gas, or too fast.

Another test applied to the same meter gave the following results:

Percentage of station meter, 1000 foot test, 99.5.
3000 foot test, 99.7.

This indicates an error of six-tenths of one per cent. the other way, or too slow a registry.

The average of the two tests is of course

$$\frac{100.35 + 90.5}{2} = 99.97;$$

thus indicating that the meter was almost exactly correct.

So much for the correctness of the registration. A slow test was next made to try the soundness of the drum. Here as the meters were run very slowly no account was taken of the temperatures, it was assumed to be the same in both, and was nearly the same owing to their proximity. The pressure was of course practically identical.

Time occupied in passage of gas, 22 hrs. 42 min.
Gas registered by standard meters..... 1573
Gas registered by station meters..... 1560

Reducing as before to percentage reading we find the registry of the station meter was 99.1 per cent. This proved conclusively that the drum was sound, and tends to corroborate the second of the fast tests.

As no error was found exceeding one per cent., and as the average of the first two trials, the only ones to be considered at all conclusive on the subject of accuracy of registration, was so very near correctness, the meter was reported correct The third or slow test was only made to prove the soundness of the drum, and was not regarded as affecting the question of accuracy.

The drum capacity of the station meter was one thousand cubic feet.

The correction for difference in pressure may be made quite near enough the truth on the assumption that four inches water pressure compresses the gas one per cent. of its volume.

The correction for difference in temperature may be made by the following table:

The Table shows the percentage of increase of the volume of Gas above its volume at the temperature of 31.4° Fahrenheit.

Temperature in Fahrenheit's Scale.	Percentage of Dilatation	Temperature in Fahrenheit's Scale.	Percentage of Dilatation.	Temperature in Fahrenheit's Scale.	Percentage of Dilatation.
31.40	0	54.33	5½	74.30	11
33.54	¼	56.24	6	75.94	11¼
35.70	1	08.12	6½	77.23	12
37.84	1¼	60.02	7	78.81	12½
39.91	2	62.00	7½	80.40	13
42.05	2¼	63.77	8	81.94	13½
44.17	3	65.63	8½	83.44	14
46.22	3¼	67.43	9	84.88	14½
48.25	4	69.18	9½	86.33	15
50.32	4¼	70.90	10	87.93	15½
52.36	5	72.60	10½	89.20	16

Astronomer Royal, Parliamentary Paper No. 339, Session 1861.

Contributions to the Theory of Luminous Flames.

BY DR. KARL HELMANN.

[Translated from the "Journal of Gasbeleuchtung."]

[Continued from page 163, vol. xxvi.]

Aided by the experience already gained, we now proceed to consider the disilluminating influence of the refrigerating burner, and of the following stream of cold gas.

It will at once be admitted that as a metal rod touching the flame, say, of a slit-burner, very near the burner-head, causes a rather considerable dark space within the flame, the head of the burner itself will also, by its refrigerating action, contribute to produce the non-luminous portion of the flame, which always exists, to a greater or less extent, immediately above it. But a second element—namely, the continued stream of cold gas—is also concerned in this result.

The disilluminating effect of the burner is naturally more conspicuous in small flames, for if the effect extends in a circle of, say, 0·5 centimetre radius, the proportionate loss will be greater in a small flame than in a larger and brighter one; moreover, in a small flame the diminution of light will extend over a greater space, because the actual temperature will not reach that of a larger flame, on account of conduction and radiation of heat, and also of excessive influx of air The diminution of light may be carried to complete disillumination, if the flame of the slit-burner is reduced by nearly closing the tap. The refrigeration, too, is considerable, if the burner presents a large surface to the flame, and is made of thick metal, as in gas-stars, cooking apparatus, or gas-stoves, in which a number of small flames issue from a thick iron plate, perforated with very small holes. If the influx supply of gas is only small, all the flames are quite blue, and the lighting effect, so to speak, *nil*. I think it may, for the same reasons, be predicted that the heat of these cooking and stove burners, especially with small flames, must bear an unfavorable proportion to the gas consumed. If the supply of gas is increased with these burner arrangements, the tips of the little flames first become luminous; openidg the tap wider, the light envelope of the much enlarged flame extends further downwards, but it never quite touches the head of the burner, the lowest portion of the flame always remaining blue.

If, then, the burner causes a diminution of light by its refrigerating action, it may, *a priori*, be asserted, that this diminution will be greater with metal burners than with burners made of some bad conductor of heat. But an assumption hitherto made, that burners of porcelain or steatite possess advantages over metal burners, has been contradicted, and a competent practical authority informs me that in practice the only disadvantage of metal burners consists in their speedier oxidation.

This would lead to the conclusion that the greater diminution of light with a good conductor of heat, if perceptible at all, would certainly not be considerable. Only experiment could decide this. As it was evidently a question of very small differences in brilliancy, especial care was requisite in the choice of the burners, and I soon found that the ordinary burners sold in the shops would not fulfil my requirements. Two precisely similar burners were required, one made of steatite and one of iron, which should consume the same quantity of gas with equal openings of the tap; for, even with an equal consumption of gas, a larger hollow in the burner, or a different position of the tap might have a sufficient effect on the intensity of the light to entirely obscure that due to the material of the burner. I therefore had two special burners made, with heads of precisely the same size, and a circular hole in each bored with the same instrument, These burners were luted on to glass tubes of equal diameter, and tested by the photometer under quite identical conditions.

The position of the tap remaining the same, the first observation showed that the iron burner consumed rather more gas than the steatite burner, but the excess was so slight that it did not prevent the greater brilliancy of light from the steatite burner being plainly perceptible:

	Degree of Light in Wax Candles.	Consumption of Gas in Litres
Steatite burner.....	0·90	36
Iron burner	0·85	37

It must, however, be remarked, that the observation of the iron burner in this case, apart from the not inconsiderable errors due to the ordinary methods of photometry, were rendered much more difficult by the very perceptible variations, both of the intensity of the light and of the gas consumption, during the first minutes of combustion. This was evidently owing to the heating of the burner; the consequent alteration in the size of the aperture, and reduced rapidity with which the gas issued, were variable elements, which, it is true, would gradually attain an equilibrium, but would still differ in every case where the mode of consumption varied.

To obviate these disturbing influences, the iron burner was cooled down to 15° Cent.=57° Fahr.—that is, retained at its initial temperature by a constantly renewed body of water, which was readily effected by passing the glass tube that carried the burner through a cork inserted in the top of a small bell-shaped glass, inverted till the orifice of the burner was on an exact level with the tip of the bell. This funnel-shaped vessel was then filled to the brim with water, so that the iron burner was surrounded by water. A tunnel tube above the vessel, and an exit-pipe, allowed the upper layer of water to be constantly renewed as fast as it grew warm.

The experiments, of which the result is given in the following table, were carried out by causing the gas (the gas works here furnish a mixture of wood and coal gas) first to pass through a meter, the index of which read per minute showed the consumption in liters per hour. The readings of the gas consumed in the flame to be tested were taken by setting a seconds teller in motion at the moment when the index of the meter pointed to a division; the position of the index was again noted when the timekeeper showed that one or more minutes had elapsed. For protection against errors or unforseen chances, I always took several readings both before and after using the photometer. The standard was the light of a stearine candle, according to which the gas-flame was regulated in the movable disc-box; here, too, I always, after the measurement, tested whether the gas-flame still equalled the candle, and in each case I took several observations on the photometer with the flame under examination. The gas pressure was in every case three inches of water.

All the photometric observations, including those given further below, were carried out in this manner. Of course, only those figures admit of comparison which resulted from experiments immediately following each other; for the quality of the gas, as was proved by direct experiment, varied a good deal at different times.

STEATITE BURNER.				IRON BURNER.			
Light in Candles.		Gas Consumption in Litres.		Light in Candles.		Gas Consumption in Litres.	
	Av'ge.		Av'ge.		Av'ge.		Av'ge.
0·12 0·12	0·12	14·5 14·7	14·6	0·16 0·18 - 0·17 0·17	0·17	19·5 20·0 19·0 19·5	19·5
0·30 0·30	0·30	22·0 21·0 - 21·3 21.0		0·30 0·30 - 0·30 0·30	0·30	25·5 26·0 - 25·7 25·5	
0·90 1·00 - 0·96 0·98		39·0 39·0 - 39·0 39·0		0·90 0·80 - 0·87 0·90		41·0 42·0 - 41·7 42·0	

It was not advisable to increase the flow of gas any further, as the different portions of the flame, in consequence of its length, would no longer have been

equi-distant from the diaphragm, and any consequent error would have been the more serious, because the weak light of the flame necessitated its being pretty close to the diaphragm.

The second and third groups of figures in the above a ble show at a glance that the steatite burner had a decided advantage, as for equal intensity of light less gas was required than with the iron burner. In the first group this is not so evident, and, in fact, if from the 14·6 litres and 0·12 light the proportion were calculated for 19·5 litres consumption for the steatite burner, the result would be rather against it as compared with the iron burner; but if the figures obtained in the experiment with one burner are tested against each other, it will be found that they are not at all proportional, but that the light of very small flames is much below the figure that would be arrived at from a proportion based on the result of experiments with a larger gas consumption. This probably arises, in the first instance, from the refrigerating action of the burner, but the loss of heat by conduction, radiation, and excess of air is greater in a small flame than in a larger one.

The results of the above table are more clearly shown if the intensities of light are considered as ordinates, and the corresponding gas consumption as abscissa in a system of co-ordinates, the appearance with increased gas consumption being represented by a curve. The curve of the iron burner is much below that of the steatite burner.

It cannot now, therefore, be asserted, that the advantages of a slow-conducting material for burners are "altogether imaginary." In the above case the advantage was not inconsiderable, chiefly, it is true, because the iron burner was kept at its original cold temperature by artificial means. Of course, a burner acting without such a cooling apparatus would heat very quickly, and attain a pretty high temperature. That the disadvantage of an iron burner is thus much lessened, and that especially with a very bright flame, it might not exercise any very perceptible influence on the intensity of the light, is easily understood; but I think my experiments have established the fact that there is a greater diminution of light with metal burners.

The refrigerating influence of a matal burner may be shown in other very instructive ways. If a cooking burner, or metal single-hole burner, is closely observed immediately after lighting, it will be seen that a wet spot is formed close round the aperture. In small flames, after burning for a short time, the condensed water becomes mixed with tarry water, which rapidly increases to a considerable quantity if the burner is kept cool by artificial means. A thick drop of tarry liquid soon collected round the aperture of the well-cooled burner used in the above experiments and threatened to stop it up. But if the burner is not cooled it gradually heats, and the condensed water is again evaporated; a brown residuum from the dried tar remains, on the upper surface of the burner is a visible proof of the great abstraction of heat effected at first by the burner.

It has been already shown that a wire inserted in a flame disilluminates it to a considerable extent, but that if the wire be glowing hot, no such disillumination takes place. By the same rule, the diminution of light occasioned by the refrigerating effect of a cold burner will cease when the latter is heated to glowing.

Unfortunately, in this experiment, it is impossible to prevent the gas-stream from becoming heated also; so that the result, which entirely confirms what is said above, cannot be exclusively referred to the cessation of heat-abstraction by the burner.

The refrigerating effect of the cold gas-stream on the already glowing gases—that is, the flame—has been already noticed in speaking of the space between the flame and the burner when compressed gas is used. As it is now also established that the light is diminished by cooling the flame, the same effect must also be produced by the freshly-inflowing gas-stream.

If we suppose that the flame could exist for a moment without the continual influx of fresh gas, it would not, even in this case, be of the same temperature throughout; as the impenetration of air, as well as conduction and radiation, would cause the outer portions of the flame to lose most heat; the hottest part would, therefore, be somewhere about the centre of the flame. If we now suppose cold gas suddenly to enter at the bottom of the flame, it is clear that the greatest diminution of heat will take place in the lower interior portion of the flame; the hottest part is, therefore, no longer in the centre, but must have moved further up, nearer the tip of the flame.

But the different pottions of the flame have all to participate in this reduction of heat, and those parts the temperature of which was previously only a little above what was absolutely necessary for the separation of carbon would be cooled below this point, that is, entirely disilluminated by the refrigerating effect of the gas-jet, while intrinsically hotter portions of the flame would only suffer a diminution of light. The colder the intruding gas is, the more will the entire light of the flame be weakened, consequent upon the joint action of all these causes, while it will be very greatly increased. and even reach the intensity of the above hypothetical flame existing without the influx of gas, if the heat-absorbing effect of the issuing gas-stream is obviated by heating it to the flame temperature before it is allowed to enter.

[To be continued.]

Hardening and Toughening Copper.

With a view to communicate great hardness, toughness and homogeneity to copper and alloys of copper, so as to better fit th m for certain industrial uses, Mr. W. E. Everitt, of Birmingham, takes oxide of manganese, preferably the native ore commonly known as black oxide of manganese, in a state of fine powder, and in the proportion of from one to six parts by weight of the said oxide of manganese to 100 parts by weight of the copper to be operated upon. He puts the copper and oxide of manganese together into the melting pot, or melting furnace, and when the copper is melted stirs the oxide of manganese well into it. As soon as the dross and scum have thoroughly separated from and risen to the surface of the melted metal, the copper or alloy is ready to be poured into ingot or other moulds. In treating brass he proceeds as described with respect to copper, adding the required percentage of zinc to the melted copper. The alloys of copper to which the invention is especially applicable are alloys of copper and zinc, but he does not limit himself thereto, as his invention is also applicable to otner alloys, of which the essential metal is copper. Besides rendering copper and alloys of copper tougher, harder, and more homogeneous, the treatment described facilitates the rolling of alloys of copper at a red heat, and thereby effects an economy of time and labor in the rolling process. Copper and brass treated according to the invention are admirably fitted for the manufacture of steam boiler tubes, bearing shafts or axles, axle boxes, sheathing for ships, and bolts and nails for the same, as well as for sheet brass and brass wire. Although in practice he has found the native black oxide of manganese to answer well, yet he does not limit himself to the use of that particular compound of manganese as other oxides of that metal, or compounds which on being heated yield oxide of manganese, may be employed with like results.—*Iron Age.*

Magazine of American History.—The August number of the *Magazine of American History*, (A. S. Barnes & Co., New York, publishers) is delivered. The leader is a long, carefully-prepared history of the uniforms of the American army, by Major Asa Bird Gardner, of West Point Military Academy. This article shows extensive and patient research, recites the origin of uniforms worn in the several Colonies, and the colors adopted by the continental army.

[This magazine is one that should be taken by all who desire to familiarize themselves with the details of many points in our history which can not be found in more general works. For the young and for those of more mature years much delightful reading is here presented in a form pleasant and agreeable.—Ed.]

British Association of Gas Managers.

Continued from page 73.

WEDNESDAY JUNE 13.

Mr. C. Woodall (London) read a paper on—

SOME EXPERIMENTS UPON POWER AND FUEL EXPENDED ON EXHAUSTING GAS.

It has happened at various times, but especially within the last few weeks, that I have had occasion and opportunity to make some careful experiments upon the power required to drive exhausters doing a certain amount of work, and upon the most economical way of obtaining power.

In offering to the Association the results of those experiments, I am influenced by a hope that they will prove of interest and service to the members, and also by the circumstance that there is so little published data on the subject.

Beyond an interesting article in *Engineering* of May 21, 1875, founded upon some experiments made by me at the Vauxhall works, and to which I shall, with your permission, refer in the course of my remarks, I do not know of any such data. This being the case, it is hardly to be wondered at that there is apparent in different gas works a vast difference in the plant provided for driving exhausters, and consequently in the money spent thereon.

While my experiments have been made with three different types of engines, the exhausters have all been of the same class—viz., the ordinary rotary exhauster patented by Mr. J. Beale, and subsequently altered, and possibly improved, by several makers. I know that many engineers who have used other forms of exhausters, claim for them advantages over Beale's but into that matter I have not had opportunity to examine. What I have attempted to determine is the power required, with a certain standard type, to do a given amount of work, and I trust we may have from members present some figures as to others.

The character of fuel used in these trials has varied—steamcoal, coke, and breeze having each been tried. As, however, in each case, the result is stated in pounds of water evaporated per 1000 cubic feet of gas exhausted, there is no confusion in the tables; while we obtained some useful comparative data as to the value of these respective fuels to steam users.

I will now proceed to describe the plant used, and the method in which the experiments were conducted; and, for the purpose of comparison, I will, with your permission, briefly quote those already referred to as published two years ago.

First, then, a horizontal non-condensing engine was used, the crank-shaft of which was coupled direct to the shaft of an exhauster designed to pass 100,000 cubic feet per hour.

Secondly, a beam engine, single-cylinder condensing, driving two exhausters, each of the same size as in the former case (100,000 feet per hour), made by Messrs. Burton, Sons, and Waller, through a system of geared wheels. The non-condensing engine had a cylinder 12 inches in diameter and 24 inches stroke, the beam 20 inches diameter and 30 inches stroke.

The steam was supplied from a Cornish boiler 26 feet long by 6 feet diameter, with a flue tube 3 feet diameter, and a fire grate 6 feet by 3 feet, or 18 feet superficial area.

The trials lasted for ten hours each day; the engines were used for exhausting only, the water being pumped into the boiler by a donkey pump worked by steam brought from elsewhere. The feed water was carefully measured, and the water in the gauge-glass brought to the same line at the end as at the commencement of the experiment. The fire was drawn at the commencement of each experiment, and again at its close, when the fuel remaining unconsumed, as also the ashes and the clinkers, were duly weighed. Indicator diagrams were taken, and the pressure of steam in the boiler observed every half hour, and the observations of the speed of the engine checked by a counter kept going through the trial. The quantity of gas passing was taken hourly from the station-meter register, and all possible care was taken to avoid error in any direction.

Good Welsh steam coal (Ballfa) was used on the day the condensing engine was at work, gas coke with the non-condensing.

The results obtained were as follows:—

	Beam condensing with two 100,000 exhausters and gearing.	Horizontal non-Condensing with one 100,000 exhauster coupled direct.
Duration of trial	10 hours.	10 hours.
Average pressure of Steam	28¾ lbs	36 lbs
Average speed of engine	29¼ revolutions.	80·6 revolutions.
Average indicated horse power	25·9	21·9
Gas Exhausted per hour	108,800 cubic feet.	106,140 cubic feet.
Vacuum, inlet exhauster	3 inches.	3 inches.
Pressure outlet exhauster	40½ inches.	38 inches.
Total fuel used	1556 lbs. (coal).	2238 lbs. (coke).
Fuel used per sq. ft. of fire grate area per hour	8·6 lbs.	12·43 lbs.
Fuel used per indicated horse power per hour	6 0 lbs.	10·22 lbs.
Percentage of dirt	7·1 per cent.	10 per cent.
Feed water—		
Temperature	60 degs.	62 degs.
Evaporated, total	14,244 lbs.	16,700 lbs.
Evaporated per hour	1,424 lbs.	1,670 lbs.
Evaporated per indicated horse power per hour	55 lbs.	76·25 lbs.
Evaporated per pound of fuel	9·2 lbs. (coal).	7·46 lbs. (coke).
Fuel used per 1000 cubic feet passed	1·43 lbs. (coal).	2·11 lbs. (coke).
Water evaporated per 1000 cubic feet	13·1 lbs.	15·75 lbs.
Indicated horse power exerted per 1000 cubic feet	0·238 lb.	0·206 lb.

The same engines were again tested last month under rather different conditions. The boiler used was again a Cornish one with single flue, its dimensions being 24 feet by 5 feet 9 inches, flue 3 feet diameter, with six 2½ inch tubes 6 feet long within it Fire grate 7 feet by 3 feet, or 21 feet superficial area.

The non-condensing engine had again to drive its 100,000 feet exhauster coupled direct, while the condensing engine drove one made to pass 120,000 feet per hour by wheels and shafting, the wheels geared two to one. Both exhausters were of J. Beale's patent, made by B. Donkin & Co.

The results in this case were as follows—

	Beam condensing engine and driving one 120,000 Exhauster and gearing.	Horizontal non-Condensing and driving one 120,000 Exhauster direct.
Duration of trial	10 hours.	10 hours.
Average pressure of steam	36·6 lbs.	34·5 lbs.
Average speed of engine	22·25 revolutions.	62·09 revolutions.
Average indicated horse power of 40 diagrams	13·56	10·33
Gas passed per hour	78,000 cubic feet.	75,000 cubic feet.
Vacuum, inlet exhauster	1·6 inches.	1·5 inches.
Pressure, outlet exhauster	27·7 inches.	27·3 inches.
Total resistance	29·3 inches.	28·8 inches.
Coke used, less cinders, per hour	1047 lbs.	1288 pounds.
Coke used per sq. ft. of fire grate area per hour	5 lbs.	6 lbs.
Coke used per indicated horse power per hour	7·7 lbs.	12·5 lbs.
Percentage of dirt	13½ per cent.	12¾ per cent.
Feed water—		
Temperature	75 degs.	73·3 degs.
Evaporated, total	7592 lbs.	10,497 lbs.
Evaporated per hour	759 lbs.	1049 lbs.
Evaporated per indicated horse power per hour	56 lbs.	101½ lbs.
Evaporated per pound of coke	7¼ lbs.	8·100 lbs.
Coke used per 1000 cubic feet	1·340 lbs.	1·750 lbs.
Water evaporated per 1000 cubic feet	9·700 lbs.	14·000 lbs.
Indicated horse power exerted per 1000 cubic feet	0·174 lb.	0·137 lbs.
Power required to drive engine alone at speed given	1¾ indicated h. power.	2¼ indicated horse power.

The largely increased weight of steam, per indicated horse power, required by the non-condensing engine in the second trial over the first, is, I think, explained by the fact that the cut-off was the same in both cases, though the work was so materially varied.

A comparison of the ultimate results of the two trials shows (as would naturally have been expected) that the power required, per 100 cubic feet, is, within ordinary limits, directly proportioned to the pressure on the outlet of the exhauster.

Needing to extend the exhausting plant at the station where these trials had been made, I determined to put down a much more economical engine than those we had been using. I, therefore, recommended the purchase of a compound condensing engine, and one of that class, of 30-horse nominal power, was accordingly procured from Messrs. B. Donkin & Co. The makers gave a guarantee that the consumption of steam should not exceed 22½ lbs. when the engine was putting out about 30-horse power, and the steam in the boiler was at 50 lbs. pressure. To ascertain how nearly this efficiency had been attained, and also with the object of obtaining a few more facts to lay before you, I had a very careful trial of this engine made last week, the details of which I will now describe—

Experiments on 30-Horse Power Steam Engine at Phœnix Gas Works, Vauxhall, June 5th 1877, made by Messrs. Woodall and Donkin.

Class of Engine.—Horizontal, compound condensing; low pressure cylinder, steam jacketed. Diameter of cylinders, 12 inches less 1-64th, and 20 inches less 1-54th from gauges; length of stroke, 2 feet 3 inches

Boiler (new), Lancashire.—Two flues draught dividing down sides, and returning under bottom. Dimensions, 22 feet long, 6 feet 2 inches diameter; flues 2 feet 4 inches diameter; grate surface 21 square feet (each grate was reduced from 6 feet to 4 feet 6¼ inches in length, and ash-pit partially closed with loose bricks to contract air space).

Pressure of Steam taken every half hour by tested Bourdon gauges—

Mean of 21 readings	35½	lbs.
Duration of trial from 9·20 a.m. to 7·20 p.m.	10	hrs.
Vacuum in condenser taken hourly.	28½	inchs.
Revolutions per minute, taken by counter	46·8	

Indicated horse-power developed in high pressure cylinder (average of	42 diagrams.	10·37
Ditto low pressure	42 "	.11·52
	84 "	21-89

Indicator Diagrams taken from top and bottom of each cylinder every half hour by four Richards's indicators—

Water from Condenser.

Initial temperature of injection water, average of 28 readings	67·79°
Ditto water discharged from air-pump, average of 60 observations	92·170
Rise of temperature in condenser.	24·38°
Height of water over tumbling bay, 3 inches wide (60 observations)	2¾ less 1-32nd
Mean discharge per minute	334 lbs.
Pounds per indicated horse power per minute	372

Water from Steam Jacket.

Quantity discharged per hour	66 lbs.
" " per indicated horse power per hour	3 lbs.

Feed Water.

Quantity evaporated during ten hours	5666 lbs.
Quantity evaporated per hour	566 lbs.
Quantity evaporated per indicated horse power per hour	25·8 lbs.
Quantity evaporated per lb coke consumed	9·46 lbs.

No water was pumped into boiler. Experiment commenced with water in gauge-glass as high as possible, and finished near the bottom, using in all 9·812 inches in the ten hours. Feed-valve shut off. The contents were calculated from very minutely-taken dimensions of inside of boiler, and checked by feeding in next day at the same pressure.

Coke.

Fair quality and size, weight per chaldron		12½cwt.
Quantity used in ten hours	672 lbs.	
Less cinders drawn from fire	73 "	
		599 lbs.
Do. per sq. ft. fire-grate per h'r.		2·85 "
Do. per indicated horse power per hour		2·75 "
Weight of dirt and refuse not burnt—		
Clinkers	20 lbs.	
Ashes	46 lbs.	
		66 lbs.

or 11 per cent. of fuel used.

Remarks.—Fires drawn at beginning and end of experiment. Steam used for no other purpose. All valves tight.

Works.—Driving one 150,000 feet per hour J. Beales's patent exhauster, with outside bearings made by Messrs. B. Donkin & Co., by straps through a short piece of shaft. Gas passed per hour, average, 73,300 cubic feet. To absorb as much power as possible, the outlet valve was closed down partially.

Pressure on exhauster (average of 20 readings	48¼ inches.
Vacuum " " "	2½ inches.
Total resistance to exhauster	51 inches.
Coke used per 1000 c. f. passed.	0·82 lbs.
Water evaporated per 1000 cubic feet passed	7·72 "
Indicated h. power exerted "	0·298 "
Indicated horse power to drive engine alone	3½

It is necessary to remember, when noticing the result of this trial, that the engine was working at a disadvantage, because of the light work upon it in proportion to its power. As it was, the result was very satisfactory.

Permit me now to call attention briefly to the points I consider worthy of observation arising out of these experiments.

First, as to the power required for exhausting. Taking out from the results the item of indicated horse power per 1000 cubic feet of gas estimated, it is as follows:

Non-Condensing Engine coupled direct to Exhauster.

Indicated horse power per 1000 cubic feet at 29 ins. pressure=0·137.

Indicated horse power per 1000 cubic feet at 38 ins. pressure=0·206.

Beam Condensing Engine driving Exhauster through Gearing.

Indicated horse power per 1000 cubic feet at 29 ins. pressure=0·174.

Indicated horse power per 1000 cubic feet at 40 ins. pressure=0·238.

Compound Condensing Engine driving Exhauster by Straps.

Indicated horse power per 1000 cubic feet passed at 51 ins.=0·298.

The same engine tested at 26 inches=0·181.
" " " 24 inches=0·162.

Average of the five experiments at 34 ins.=0·199

And from that average I conclude that, allowing for the constant of the engine, which would become a larger percentage of the whole as the pressure was reduced, the power required to exhaust 1000 cubic feet of gas against a pressure of 15 inches under average conditions is equal to from 0·095 to 0·1 of an indicated horse. Of course, if the arrangements for driving are complicated the power will be greater, and where the exhausters are driven direct, without the interposition of gearing straps, it will be less. I would again remark that I am here treating of rotary exhausters of the Beale pattern only; no doubt some of the other forms in use require less power, while again others may take more. On this subject we may hear something from members present.

I turn now to the question of the most economical way of obtaining the power. Taking out the item of water evaporated per 1000 cubic feet of gas exhausted, the figures stand thus—

Non-condensing, against 41 ins pressure....		15·73 lbs.
Beam " " 43 " "		13.09 lbs.
Compound " " 51 " "		7.72 lbs.

I prefer, however, to take as the item for comparison the water evaporated per indicated horse power. Questions of gearing or straps or direct action would of course affect every engine alike, and the experiments I have detailed show, so far as they go, to what extent. These are expressed, however, in the power exerted, and the steam used to obtain the power is the measure of the efficiency of the engine. This comparison stands as follows—

Water Evaporated per Indicated Horse Power.

Non-condensing engine.....		76·25 lbs.
Beam " "		56.00 "
Compound " "		25.00 "

I leave out the second trial of the non-condensing engine, which gave 101 lbs. per indicated horse power for the reason already given.

Now I have already shown that the average power put forth in these experiments amounted to 0.199 indicated horse power per 1000 cubic feet of gas exhausted, and that a correction for pressure from 34 inches, the average of my trials down to 15 inches, which is more nearly the average met with on gas works, would give 0·1 as the power requisite per 1000 cubic feet. From this I deduce the following figures, taking for illustration a gas work making 50,000 cubic feet per hour, and assuming that make maintained through the year.

Water to be Evaporated per Hour.

Non-condensing engine..	76·25×0·1×50=381 25 lbs.
Simple " " ..	56·00×0·1×50=280·00 "
Compound " " ..	25·80×0·1×50=129·00 "

Taking coke as the fuel to be used, and putting its evaporative power per lb. at 7·5 lbs. of water, the consumption comes out—

No. 1. 381 25×24×365=3,339,750 divided by 7·5 divided by 2240=198·8 tons.

No. 2. 280·00×24×365=2,452,800 divided by 7·5 divided by 2240=146·0 tons.

No. 3. 129·00×24×365=1,130,000 divided by 7·5 divided by 2240=67¼ tons.

For the works where the trials were made, and at the average pressures there, the consumption of coke amounts to 728, 533, and 285 tons respectively.

Assuming the coke to be worth 12s. per ton, the comparative cost would be—No. 1, £121 8s.; No. 2, £87 12s.; No. 3, £40 7s.

I need hardly point out that the saving effected by the use of an economical engine is by no means confined to the diminished cost of fuel. The saving in boilers and water evaporated may fairly be set against the increased cost of the engine, but the saving in labor is a clear gain. In my own case that amounted to one-half, for we found, as soon as our new engine was started, that one man could do comfortably the work which had fully occupied two before.

On the question of fuel it is often urged that saving in that direction is of small moment on a gas works; that the disposal of coke and breeze is frequently so difficult, that the better price obtained for a smaller sale covers a wasteful expenditure. With this view I cannot coincide; the quantity of fuel saved will be sold at the market price, and that should content us. For my own part, I cannot see why we should not be as pleased to produce cheap coke as cheap gas, and I am often surprised to see how earnestly companies strive to maintain a high price for their coke in order that they may slightly reduce the price of their gas. The former is purchased by as large a number of consumers probably as the latter, and those of a class to whom a low price is of even greater moment. So long, therefore, as the price of gas is within the parliamentary standard, I see no reason for studying one class of consumers more than another.

I have to apologize to the Association for the bare way in which my figures have been presented, and to express a hope that they may possess sufficient interest to to excuse their dryness.

Mr. R. O. Patterson (Cheltenham) was pleased to see that Mr. Woodall had incorporated in his paper the experiments recorded in *Engineering* in May, and had compared them with those more satisfactory trials which he had subsequently made. He was pleased, moreover, that Mr. Woodall had not only given the meeting the results of his trials, but had worked them out in such a way that they would be of great service to the members in making their own comparisons When he (Mr. Patterson) was working up the paper he had the honor to lay before the meeting on the previous day, he made some experiments with his boiler, comparing results with those recorded in *Engineering*. It would, perhaps, be wearisome to read the figures, but he should be pleased to have them inserted in the report, and taken as part of his remarks. (The following paper was handed in)—

The water evaporated per foot of grate surface, he found, in the experiment to which Mr. Woodall referred as having been recorded in *Engineering*, was 2·86 lbs. in the arrangement when coke was used for fuel, and in the experiment he (Mr. Patterson) made himself, he found the consumption of fuel was 1 27 lbs. of coke. He was not quite sure what gave rise to such a great difference. It would, however, be open to investigation and question. The consumption of water per 1000 feet of gas exhausted was, he thought, given in *Engineering* as 15·75 lbs., in the worst type of engine Mr. Woodall referred to; and in the case of the steam-jet which he, Mr. Patterson, had recorded, the consumption was 19·18 lbs. in the one case, and 24·62 lbs. in the other. He thought, therefore, the results of Mr. Woodall's experiments went to prove most conclusively that some steam engines were more economical than others, and than the steam-jets in use at the present time.

Mr Morton (London) remarked that Mr. Woodall mentioned how his exhausters were driven in the first two cases—one was direct acting from the crank-shaft to the shaft of the exhauster, the other by the intervention of an intermediate shaft and gearing. But he did not mention how the third was driven, and it would be interesting to know what was done in that case.

Mr. Woodall said he did not expect a discussion on his paper, and, in fact, had intended to offer it for the use of the Association in the way that Mr. Patterson had offered his tables. But he thought, upon reflection, that it was a matter which might very fairly be brought before the meeting, in the hope that some manufacturers, amongst the extra-ordinary members, might favor them with some particulars of machinery produced by themselves. As to Mr. Morton's query, he might remark that he did state in his paper that in the third case he was driving from the engine by straps from a short piece of shafting. The reason why he did that was that he preferred to have one good engine, as being more economical than a number, requiring both less attention and less fuel.

The President said the importance of Mr. Woodall's paper must not be estimated by the short discussion that had taken place upon it. In truth, its value was

	Phœnix Gas Company. From *Engineering*, May 21, 1875.	Cheltenham Gas Company, April, 1877.		
Boiler	26 ft. long by 6 ft diam.	Galloway, 16 feet long by 5 feet diameter. One flue.		
Fire grate	6 feet by 3 feet.	6 feet 2 inches, by 2 feet 6 inches.		
Gross flue heating surface	584 feet superficial.	270 feet superficial.		
Ratio of gross heating surface to fire grate area	32·44 : 1	17·42 : 1		
		No. 1.	No. 2.	No. 3.
Coke burnt	2,238 lbs.	8,064 lbs.	5,012 lbs.	3,052 lbs.
Water evaporated	16,700 lbs.	41,016 lbs.	22,946 lbs.	18,218 lbs.
Water evaporated per lb coke.	7·46 lbs.	5·08 lbs	4·57 lbs	5·97 lbs.
Mean temperature of feed	62 deg. Fahr.	49° Fah:	42° Fah.	46° Fah.
Mean pressure of steam	36¼ lbs.	52·6 lbs.	52·2 lbs.	52·6 lbs.
Ashes at end of trial	119 lbs.	504 lbs.	342 lbs.	224 lbs.
Clinkers at end of trial	106½ lbs.	196 lbs.	146 lbs.	98 lbs.
Ashes and clinkers in percentage of fuel used	10 per cent.	8·67 per cent.	9·75 per cent.	10·55 per cent.
Water evaporated per square foot of gross heating surface per hour	2 86 lbs.	1·27 lbs.	1·18 lbs.	1·41 lbs.
Coke burnt per square foot of grate per hour	12·43 lbs.	4·33 lbs.	4·49 lbs.	4.10 lbs.
Mean speed of engines in revolutions per minute	80·61	...	...	..
Mean indicated horse power	21·90	..	...	...
Consumption of water per indicated h. power per hour	76·25 lbs.	...	...	...
Gas passed per hour	106,140 cubic feet.	17,983 cub. feet.	18,847 cub. feet.	15.229 cubic feet.
Vacuum on suction of exhauster	3 inches.	0·85 in.	0·93 inches.	0·62 inches.
Pressure on delivery side of of exhauster	38 inches.	11 50 in.	10·80 inches.	17.03 inches.
Total resistance to exhauster.	41 inches.	12·35 in.	11·73 inches.	17·62 inches.
Horse power required to exhaust 1000 cubic feet of gas	$\frac{21·90}{106·14}$ = ·2063 HP.	...	...	...
Consumption of steam required to exhaust 1000 cubic feet of gas	$\frac{21·9×76·25}{106·14}$ =15·73 lbs.	19·18 lbs.	16·83 lbs.	24·92 lbs.

very considerable; it furnished a kind of information, the importance of which could not really be over-estimated. It was a paper consisting of practical statistics, and would enable the members to study and compare notes, and see whether they could come at all up to the standard of the writer, who, it was well known, was a very exact experimenter, whose results might be accepted without any question whatever. But beyond all that, it opened up a wide field—the question of fuel for driving exhausters. It was not to be considered as a question by itself. There were correlative advantages and disadvantages, and the additional expenditure of fuel in some instances might be possibly compensated for in other ways. He was sure he expressed the feeling of the meeting when he said the Association were much indebted to Mr. Woodall for his paper.

Mr. W. J. Warner (South Shields) read the following paper on

PERIODICAL DISTRICT PRESSURE TAKING.

In the development of the manufacture and distribution of gas, the latter, during the last few years, appears to have made the greatest progress. While in carbonizing, condensation, and purifying there has been little improvement, governors, main and service laying, meters, and public lighting have, in some respects at least, nearly approached perfection. The results of such improvements, too, are manifest—a more satisfactory supply, and unaccounted for gas considerably diminished. Though thus the distribution is improved, there is still another matter that demands our attention in connection with it—I should say upon which an assured satisfactory distribution is entirely dependent—a knowledge of the service or distributory pressure of each of the districts into which a town may be divided.

The pressure is the pulse of the system, therefore there can be no true regulation of the system without an intimate acquaintance with the pulse. The economy arising from the improved condition of the distributory plant is considerable, but a more intimate knowledge of this pulse-beating would result in a greater economy in some instances, and an improved consumption in others. It is remarkable that this matter has received so little attention, as almost in every gas works the initial pressures are well regulated and governed by delicate apparatus, and the pressure faithfully and continuously recorded and registered; but these initial pressures should be determined by a chart of the service pressures through the whole period of lighting. The necessity for this will be obvious upon a moment's reflection of the varying conditions of lighting through the year. Thus, in a district with large works and factories, and mains of scarcely sufficient calibre, an alteration of pressure should be at once made upon the closing of the factories at five or six o'clock, so in a large commercial town, on the closing of the shops in many cases, a change of pressure may be made with advantage; but such changes can only be made through a familiarity with the pressures distributed over the whole of the districts.

I think I may venture to use the name of Mr. Foulis in connexion with this subject. I believe he is so thoroughly impressed with the importance of attending to the pressures beyond the works, that he contemplates a thorough organization of this work, employing men specially for it; and the beautifully compact governor which I have the privilege of placing before you was designed for the better regulation of district pressures.

Again, consider the changes that take place in every district from extensions, opening and closing of new works, etc., and the importance of the subject will be apparent. But, beyond these disturbing causes and the change of seasons, there are those arising from stoppages by naphthaline, sinking of mains, and neglected or forgotten syphons, which can be detected only by the pressures being taken thoroughly and systematically over the whole of each district; and such is necessary to forstall complaints, to determine initial pressures, and to adjust district governors.

This subject appears, however, to have escaped writers on gas matters; and it has not, I believe, received any attention from this Association. I know of but one reference to it—it is in the JOURNAL OF GAS LIGHTING, 1852—and that notice came through a communication from myself to the late Mr. Barlow. In 1851 I had to report to the directors of the gas company, in the neighboring city of Bath, upon the subject of distribution, and said in my report, "To complete the whole arrangement, and to extend, as it were, the system into futurity, quarterly reports of pressures in various localities are provided for, and, if made, will give timely notice of attention being required to be given to the mains." This and other matters in connection with my arrangements for systematizing the work of distribution, I communicated to Mr. Barlow in the course of 1862, and in December there was published in the "Circular to Gas Companies" a paragraph as follows: "We have so often experienced the want of proper records of pressures taken at different points over a whole district, during the maximum consumption of gas, in places where we have been called upon professionally to advise as to proposed enlargement of the mains that we would suggest to managers of gas works the advisability of making observations of the pressure in the mains in various parts of their districts between the hours of 5 and 7 P. M. for several evenings during the rest of this month; such records will be invaluable for reference in future periods."

It will be observed that this is a much lower standard than the one I had arranged to be worked to. Mine was a periodical taking, which is not alluded to in the paragraph. The minimum pressures, too, are as important to the company as the maximum is to the consumer. both alike should be taken, and taken periodically. The minimum pressure, I should say, is now becoming of more consequence to companies than the maximum. The latter may, in a measure, look after itself, but as the referees in London will now look after the former, and as the results of these testings will be attended with penalties, this subject must now be dealt with as the testing for illuminating power—by careful periodical testing. "According to the provisions" (as per letter to the JOURNAL by Mr. A. Vernon Harcourt, April 17, 1877) "of The Gas-Light and Coke Company's Act, 1876 (sections 27, 42, and 52), and the identical provisions of the South Metropolitan Gas-Light and Coke Company's Act, 1876, the Gas Referees are to prescribe the mode to be adopted for testing the pressure of gas supplied by the company, and the number of the times of testing; the average of all the testings of pressure prescribed under this Act from midnight to sunset, and the average of all the testings of pressure from sunset to midnight shall be deemed to represent the pressures during each of these periods;" and "if on any day, whether during the period from midnight to sunset, or during the period from sunset to midnight, the gas supplied by the company from any station is supplied at a pressure less than it ought to be under this Act the company shall forfeit a sum not exceeding £10 for each station, in respect of which they are so in default." The minutes of evidence on the Metropolis Gas Companies Bill, 1875, shadow forth the adoption of a system of taking pressures at all times over the whole of the ramifications ot the gas companies mains. Thus, question 7312 is - "Can it be necessary day by day, in the absence of any complaint, to do it?" To which Mr. Keates answered: "I can give a very good reason for that; I think the pressure ought to be taken." Again, Dr. William Pole, at 7329 says: "If it is desirable that some check should be put upon the company as regards the pressure, the only feasible plan seems to be that the pressure should be tried from time to time, at different places, by some inspector appointed for the purpose on behalf of the public." Again (7338), the same witness (and he is a gentleman, I need not add, of no mean authority in gas matters) says: "I believe the pressure should be tested not at any fixed station, but at several points in the district."

Thus far for the principle; but the difficulty appears to have arisen in the carrying of it out. Mr. Keates says (7311): "I do not say that there is any difficulty in an engineer going and putting a pressure guage upon a main, but as a working thing, from day to day, it is impossible." So at 7329 Dr. Pole, in a memorandum which he read, says: "The Referees could only prescribe that the pressure should be tested at certain hours at some fixed station. But this would give no assurance that the pressure should be, as stipulated in clause, 6-10ths or 10-10ths, at the main near the junction therewith of every customer's service-pipe." I doubt whether there is any feasible mode of testing systematically the fulfilment of the conditions of clause 8."

From our own practical experience we cannot but endorse the evidence of these gentlemen. For our own purposes we should have the power of taking the pressures over a whole district, that such pressures should be taken at the mains, but there has not hitherto been "any feasible mode of testing systematically."

Taking pressures either from the inside of houses or from the public lamps is most unsatisfactory, as all know who have attempted it; indeed, most troublesome vextatious in winter weather, as well as unreliable at all times; besides which, if the district is at all extensive, it is impossible to get through it in one night during the hours of maximum consumption.

To take district pressures, then, it is necessary there should be a ready means of communication with the mains themselves, that the pressures taken should be reliable, that the apparatus should be strong and simple, that it should effectually prevent any loss of gas, there should be no possibility of danger from covers being left open in roads, and the price should be a moderate one. How far my patent stand-pipe valve, which is now before you, and was described in the paper I had the honour of reading to the Association last year, answers to the requirements I must leave you to determine; suffice it to say that a large and short gas-way only is required from the main to the cock, which is considerable—made proportionate to a three-quarter cock for iron tubing. The junction of the pipe of the pressure-guage is simple and effectual, and cannot get out of order, being a bayonet joint and an india rubber washer. The gas must be turned of before the pressure-guage tube or stand-pipe can be withdrawn. The arrangement of covers precludes dirt and water and liability to damage by being left open, the outer one closing by its own gravity. There is no special arrangement of the pressure guage necessary for this work. I prefer the ordinary one enclosed in a tin case, with cocks to close connexion with air and gas, so that the water may not be disturbed in carrying.

The positions for taking the pressures, as I have them arranged, are along the trunk and leading mains a short distance before and after the junctions with the branch mains: at those positions where the mains are diminished, at the foot, top, and up the sides of hills; along the principal streets; and at the extreme ends of the districts.

The forms for entering these pressures into, as taken, I have placed before you, a sheet being given to the inspector for each taking, from which the work is to be copied into a book. Each stand-pipe valve being numbered, the pressures can be compared with each other and the initial pressures, which can only thus be regulated for the maximum and minimum for each of the four seasons of the year.

My subject is not so attractive as I could wish, but I think it must be a suggestive one, as I know of very large districts where the work is never done; and I feel assured there is an earnest desire amongst the members of this Association—which the Association has encouraged, if not engendered—to supply, as efficiently and economically as possible, the several districts committed to their care, without regard to thei, position, importance, or magnitude.

District Pressures (Maximum) Mouth of January.

Street or Place.	Stand. Pipe Valve No.	1865. Jan'y 8,		1366. Jan'y 11.		1867. Jan'y 5.	
		Time.	10ths of an Inch	Time.	10ths of an Inch.	Time.	10ths of an Inch.
Initial Pressure.....	...	...	20	...	20	...	20
		P. M.		P. M.		P. M	
Albion street	1	5.0	18	5.5	19	5.0	17
Hurworth Place.....	2	5.10	17	5.12	16	5.8	16
Curzon st,...	3	5.15	17	5.16	16	5.11	15
Queen's Sq.	4	5.25	16	5.25	15	5.20	14
Market st....	5	5.30	14	5.30	15	5.25	12
—	10	6.0					
—	20	7.0					

The same form is used for minimum pressures.

The PRESIDENT said Mr. Warner had dealt with a most important subject. He had been personally acquainted with many companies in which half a dividend had been wasted for want of such simple means as Mr. Warner had indicated. These were matters which could not have too much attention. The waste which constantly occurred for want of a due regulation of pressure at different parts of a district was most serious. In some places there would be perhaps three or four times as much as was wanted, whilst in others there would be a deficiency, the constant source of complaint and annoyance. Mr. Warner deserved thanks for bringing the question before the Association.

To be continued.

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,

PROPRIETORS.

Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH

At No. 42 Pine Street, New York.

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LIGHT, HEAT, MINING INTERESTS, STEAM,
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TERMS

SUBSCRIPTION—Three Dollars per annum, in advance.

AGENTS

NEW YORK—AMERICAN NEWS COMPANY, 119 and 121 Nassau St
BOSTON—S. M. PETTENGILL & Co., 6 State Street.
PHILADELPHIA—COE, WETHERILL & Co., Ledger Buildings Phila.
Germany—B. WESTERMANN & Co., of New York.

MONDAY, SEPTEMBER 2, 1877.

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

G. S. D., the Great Water Gas Chemist! A Wonderful Discovery?

NEW YORK, August 27. 1877.

Mr. Editor: A communication appears in a scientific paper of this city, issued August 25th last, written, evidently, by a learned chemist, signed "G. S. D." in which it is stated that an analysis of a certain water gas shows but three per cent. of CO, and twenty-five per cent. of CH_4. Nothing is said about the balance of the gas, but, there being no O, it is probably, mostly H. It is unnecessary to inform your readers that no CO_2 or but traces of it, according to the previous claims of G. S. D., is made by this interesting process.

To a "prejudiced reader, and one preferring not to understand," a classification adapted by G. S. D., it would appear that this was not the analysis of a water gas at all, but rather of an oil gas, or a mixed oil and coal gas, *very* distructively distilled, or passed through a hot gasogen and regenerator. But the distinguished chemist G. S. D. explains the analysis as follows:

"The fact established in the laboratory of a French chemist (whose name I cannot recall) that at a very high temperature C will, despite its strong affinity for O, forsake it and combine with the due proportion of H to form CH_4, is illustrated here, and accounts for the marsh gas, while the principle of the disassociation of gases is also shown, and undoubtedly holds the O in suspension (what a strong principle this must be) until in the reduction of the temperature it combines with its due proportion of the surplus H to form water."

Now a "prejudiced and ignorant reader" might say that the nameless French chemist never existed, and never made the experiment referred to, because no man would, or could, have C, and O, and H mingled together, in a gaseous condition, in the proportions named, and at a very high temperature, for the books say, and experience confirms them, that *the result would be a terrible explosion.* But the "prejudiced reader" should know that, by the Lowe process, things before considered impossible, and contrary to physical and chemical laws, are rendered possible and easy. The Utica explosions to the contrary notwithstanding.

The "prejudiced reader" might use a little old process, plain arithmetic, in examining this discovery of G. S. D, as follows:

1. We take seven thousand grains (or one pound) of steam consisting of 778 grains of H. and, 6222 grains of O, making, when converted into gas, 21 cubic feet of H, and 10½ cubic feet of O, or, to make 100 cubic feet of gas, consisting of 66 cubic feet of H, and 34 cubic feet of O, would require (3.10) three and one-tenth pounds of water.

2. We take the figures of G. S. D.'s *astonishing analysis* of a water gas, where all the O present is that found as CO, amounting to three per cent! This fact is stated by G. S. D. as follows:

"What becomes of the O which in the decomposition of the water should by all former precedents, unite with C and form CO, *but which has entirely disappeared from the gas, except to the small extent mentioned?*"

3. We also take it that twenty pounds of carbon are required to produce 1000 cubic feet of water gas, or two pounds to the hundred cubic feet. It is relaly a little under seventeen pounds to the thousand, but the round figure is near enough, it does not do to figure too closely with these great discoverers

4. We take as true, simply for the sake of argument the discovery of G. S. D., that the O, uncombined with C, combines with the surplus H to form OH_2.

We are now prepared to show that all the discoveries of the great men of the past and present, have been eclipsed by the eminent G. S. D., as follows:

G. S. D. starts with (1) 100 cubic feet of gas, or 66 cubic feet of H, and 34 cubic feet of O; now by (2) as per G. S. D., only three per cent. of O is found after the decomposition by means of the incandescent carbon, and this in the form of CO. This leaves thirty-four, less three, or thirty-one cubic feet of O to be accounted for. This thirty-one cubic feet of O, per G. S. D., (4) combines with the surplus H to form OH_2, or water. It would require sixty-two cubic feet of this surplus H to combine with the thirty-one cubic feet of O to form OH_2.

Now G. S. D., if an ordinary mortal, would have left, from the 100 cubic feet of gas started with,

Hydrogen 66—62 = 4 cubic feet.
Oxygen 34—31 = 3 cubic feet.

or seven cubic feet of gas in all, the balance being water. One might exclaim here, that this must be an expensive method of making gas, *to waste 93 per cent. of it after it is made, by reconverting it into water:* but this is "prejudice."

But G. S. D. not being an ordinary mortal, discovers that from 100 cubic feet of gas, weighing three and one-tenth pounds, and two pounds of carbon, he has made 100 cubic feet of gas sp. gr. .575, weighing four and a third pounds, also $\frac{(21700-1546+145)}{7000} =$ two and eighty-three hundredth pounds of water.

Or that, having certain matter weighing five and one-tenth pounds in all, he has made from it other matter weighing seven and one tenth pounds in all. The difference between what G. S. D. starts with, and finally obtains, viz., two and three one hundredth pounds, or an increase of forty per cent. in weight, *has come from nothing, or has been created by the great G. S. D.*

Consequently the maxim, *Ex nihilo nihil fit*, no no longer confronts the experimenter; G. S. D., has an-nihil-ated it.

Now, Mr. Editor, may I ask, how the opinions of your "prejudiced readers," those who are not already satisfied as to the character of G. S. D., will be affected by the latest effort of his? Yours, X.

Coal in Chili.—The great coal mine of Los Christales, at Cauquernes, in Chili, which has been lost for forty years, has been found and will in future be worked by English capital. It was abandoned at a time when the Chilians were in insurrection. It then filled up with water, and an avalanche slid into and over it, and for forty years its whereabouts could not be ascertained.

Gas-Light Intelligence.

United States.

PERSONAL.—Mr. William King Esq., Chief Engineer of the Liverpool Gas-Light Company, arrived by the White Star steamer Germanic, on last Saturday, and will spend a few weeks visiting points of interest in the United States.

REDUCING THE PRICE OF GAS.—At a meeting of the directors of the Metropolitan Gas-Light Co., of New York, held August 23d, it was resolved to reduce the price of gas to consumers from and after the first of September next, to the following prices, viz.:

Consumers of less than 30,000 cubic feet per month $2.25 per 1000.

Consumers of 30,000 to 50,000 cubic feet per month, $2 per 1000.

UTILIZING AN ELECTRIC APPARATUS.—It has been discovered that the wires of an electric apparatus used in Providence, R. I., for lighting street lamps, can be utilized so that any policeman, wherever in the city he may be, can talk with an officer at head-quarters, by simply stepping to a lamp-post and attaching to the wire a small telephone which is carried in his pocket.—*Commercial Advertiser.*

CONSUMERS' MUTUAL GAS COMPANY.—Notwithstanding the fact that the Consumers' Mutual Gas Co. is not so regardful of public convenience as it might be it appears to solicit public favor successfully. Whether it would do so if its affairs were laid open to public inspection, is at least questionable. Its ex-president having sued for only ten thousand shares of stock he never paid for, and mutterings of similar discontent on the part of other "bonus" officials being heard, the inquiry is suggested whether any capital stock of this "mutual" concern was ever taken and paid for, or if it is all of the "bonus" character. These are questions the answers to which might serve to enlighten investors who are now asked to come up and buy the Consumers' Mutual Gas Company first mortgage bonds.—*Baltimore Bee.*

A GAS QUESTION.—At a late meeting of the Board of Aldermen of Jersey City, permission was granted to the Consumers' Gas-Light Co, to lay pipes in that city. At the next meeting they were required to file $25,000 worth of bonds. Now an injunction has been served on the projectors of the new company, issued at the instance of the Jersey City and Hoboken Gas-Light Co. It requires the new company to show cause on September 3rd, in the Vice Chancellor's Court at Newark. why the injunction should not be perpetual.—*Newark Daily Advertiser, Aug,* 24.

[It has been intimated that the head center of this opposition gas movement in New Jersey, will be found in extremely hot water ere long. We all know what is meant by "Jersey Justice," and that it is no small matter to be indicted for perjury over there. We understand that, before pipes are laid under the North River to supply this city with gas made in Jersey City some interesting developments are to be made in the New Jersey Court of Chancery, that will not only postpone this engineering feat, but may seriously compromise the character of its engineer. We shall keep our readers posted.]

Great Britain.

THE VALUATION OF LIME AND GAS LIQUOR.

Sir: As you appear to be inundated with claims o originality for the simple means of ascertaining the amount of ammonia, whether fixed or otherwise, in gas liquor, I may mention that, for the last 35 years, I have had in constant use a similar apparatus for testing gas liquor; I, however, used it for another and equally important purpose—viz., for ascertaining the value of lime; that is, to what extent it was pure lime, and also for ascertaing the amount of caustic

ime left in lime after it has been taken out of the purifier.

The action was very simple. Take, say, 50 grains of the lime to be tried, put into a flask with some water, and, say, 150 grains of muriate of ammonia Heat the whole to boiling, and collect the ammonia given off into a vessel of cold water. Then, by means of a solution of test acid, the quantity of ammonia is arrived at, and by a simple calculation the quantity of caustic lime.

In these days of lime purification, the value of a lime is very important, as well as a knowledge of the amount of lime left unacted upon in the purifier.

June 30, 1877. F. I. E.

—*Journal of Gas-Lighting.*

Chemical and Scientific Repertory.

Coal.—The production of coal is increasing. By comparing the statistics of tonnage of this year with the same time of last, the anthracite shows an increase of about one quarter; bituminous, for the same time, a decrease of aboat 1.240.—*Polytechnic Review.*

Waterproof Leather.—Melt 1 litre of boiled linseed oil, 125 grammes of suet, 46 grammes wax, and 32 grammes resin together over a slow fire, and apply it to the leather with a brush while warm. This composition keeps the leather very soft. The English fishermen have long been using it. They can remain in the water for hours ere it penetrates through the leather. The only thing new in the compound is the addition of wax and resin to the fatty matter.—*Bay. Ind. und Gew. Blatt.* vol. xix. 212.

French Blacking—Twenty ounces ivory black, sixteen ounces New Orleans molasses, five onnces linseed oil, one ounce sulphuric acid, one-quarter ounce indigo, one-half ounce of mucilage; mix the black and molasses well, so as to get out all the lumps; next add the oil; then by degrees the acid, and as much water as may be required to form a paste.

Burning Petroleum Under Steam Boilers.—Successful experiments have recently been made in Italy on a method of burning petroleum under steam boilers, which consists simply in pouring the oil over a thin layer of asbestos. The petroleum burns with intense heat, while the asbestos, being incombustible, is not affected, but serves as a means of retaining the oil and acting as a wick. During the experiments sheets of paper placed beneath the furnace were not injured, although the heat from the oil above was most intense.

Reclamation of the Zuyder Zee.—Active preparations are going on for the commencement of the long projected work of draining the Zuyder Zee. A dam nearly twenty-five miles long is to be carried across the gulf, and upon this pumping machines of 10,000 horse-power are to be placed, capable of discharging 6,500,000 cubic metres of water daily from the enclosed sea. It is estimated that the work will occupy sixteen years, and that it will cost 335,000,000 francs. The scheme, if completed, will form one of the greatest engineering feats of the world. It will change fishermen to farmers, and redeem the long lost acres from the floods, while the cities that have for centuries been buried may come to light also.—*Engineering News*, iv. 212.

Influence of Pressure on Combustion.

BY L. CAILLETET.

[Translated from the *Comtes Rendus* of February 22, 1875, for the Journal of the Franklin Institute, by Chief Engineer Isherwood, U. S. Navy.]

In a communication made to the Academy in 1868, M. H. Sainte-Claire Deville developed a complete plan of the researches commenced in his laboratory at the Normal School, and based on combustion under pressure.

The experiments forming the subject of this note were conducted according to the principles laid down by M. Deville, and although they were not executed in a laboratory with iron sides and sufficiently large to hold the experimenter and his instruments, yet they were performed with apparatus, which, if not allowing precise calometric measures, had the advantage of being able to show how the phenomena of combustion are modified under pressures which could be carried to 30 or 35 atmospheres.

In order to study the modifications effected by pressure upon the luminous, calorific, and chemical rays from a body in ignition, its combustion had to be maintained during a considerable time; and, consequently, quantities of compressed air, sometimes amounting to hundreds of quarts, had to be provided.

The apparatus employed consisted of the pumps and reservoirs for the compressed gas; the pumps had movable cylinders and fixed pistons, and their leather packings were covered with a column of water or glycerine, which both cooled the compressed gas and prevented its regurgitation. Some canvas tubes, coated with caoutchouc, enabled the gas to be easily directed into either the apparatus for combustion, or into the cylindrical reservoirs, which were of wrought iron, and had been tested to 60 atmospheres.

The laboratory apparatus was a hollow iron cylinder, banded, and having a strength exceeding 300 atmospheres. Four apertures, at about the middle of its height, were fitted with: 1st, the conducting tube for the gas; 2d, the evacuating cock; 3d, the manometer; and, 4th, a plate of thick glass for observation inside. Within this cylinder, which had an interior diameter of 4 inches, and a capacity of about one gallon, either lamps or the substance to be burned could easily be placed. It is closed by a gum joint, pressed by a blunt metallic screw, whose manipulation s facilitated by a system of counterweights.

When a wax candle is placed in the apparatus just described, the brightness of its flame increases with increased pressure of the air introduced. The base of the flame. which in the atmosphere is transparent and slightly blue, becomes white and very luminous; but very soon the phenomena change, thick clouds of smoke fill the apparatus, and escape through the evacuating cock.*

The flame viewed across the smoke was reddish; and, when the experiment ended, the candle-wick was found highly carbonized. The combustion had become incomplete, for considerable quantities of soot were deposited, due, without doubt, to the dissociation of the carbureted gases by the increased temperature of the flame; but the increase was not sufficient to burn a red-hot iron fil e.

The brilliancy of the flame of phosphorus did not seem to augment under pressure. Potassium burned with a violet colored and very brilliant flame.

Some lighted wood charcoal in a small furnace, was placed in the laboratory apparatus, and the pressure of the introduced air raised to 25 atmospheres, but the combustion did not seem more vivid than in free air.

An alcohol lamp, whose wick is only a single thread of cotton, giving in free air a scarcely visible flame, increased rapidly in brilliancy as the pressure increased. Under from 18 to 20 atmospheres, it emitted white light as bright and luminous as that of a a wax candle; its spectrum was continuous and more expanded than under the ordinary pressure; and the D alone visible, seemed sensibly widened.

The sulphide of carbon gave, also, a more brilliant and luminous flame than free air; and in burning did not produce sensible quantities of sulphuric acid.

Zinc and hydrochloric acid were placed together in the laboratory apparatus, so as to furnish a jet of hydrogen, but that gas could not be inflamed. An arrangement of the apparatus was tried to prevent the hydrogen produced from being driven back into the flask on the admission of the compressed air; but the experiment did not succeed, owing, doubtless, to the slowness with which the acid attacks zinc under pressure.

To sum up: the dissociation of the carbureted gases from the wax candle, and the appearance of the spectrums examined, show the temperature of the combustion to have increased with the pressure, but not in any very great degree.

The brilliancy assumed by the alcohol flame, as well as the coloring of the flames of sulphur and of the sulphide of carbon, show what intensity the luminous rays can acquire by increase of pressure.

That the chemical rays have a greater activity with increased pressure was established. For that purpose a number of flattened tubes containing phosphorescent substances were joined to the bottom of a blackened box, placed in grooves or guides before the window of the laboratory apparatus. These substances had been selected in such a manner as to give the colors of the spectrum when exposed for a moment to the rays of the sun. It was discovered that several pyrophores, which were not influenced by a given flame, became luminous when the pressure increased; and that those which were influenced by a flame at ordinary pressure, became more splendid when the body producing that flame was burned under high pressures.

*The production of this smoke cannot be attributed to want of oxygen, because the air which escaped by the evacuating cock, normally maintained the combustion of another candle placed under a bell-glass just outside the apparatus.

A New Theory of the Solar Spectrum.

Important scientific discovery by pro. h. draper.

At a meeting of the American Philosophical Society, held in this city, Friday evening last, Prof. Henry Draper, of New York, read a paper on his "Discovery of Oxygen in the Sun by Photography, and on a new theory of the Solar Spectrum." The coincidence of bright lines of bands in a photograph o the solar spectrum with the oxygen lines in a photo graph of a spectrum of air, was clearly shown b photographs accompanying the paper, and fully se forth in the text. It is not practicable to explain thi in a newspaper report except by reproduction of the photographs themselves. Perhaps the following quotation from the paper of Professor Draper will give to scientific men a key to the nature of the discovery."

"*Oxygen discloses bright lines or bands in the solar spectrum*, and does not give dark absorption lines like the metals. We must therefore change our theory of the solar spectrum, and no longer regard it merely as a continuous spectrum with certain rays absorbed by a layer of ignited metallic vapors, but as having also bright lines and bands superposed on the background of continuous spectrum. Such a conception not only opens the way to the discovery of others of the non metals, sulphur, phosphorous, selenium, chlorine, bromine, iodine, fluorine, carbon, etc., but also may account for some of the so-called dark lines, by regarding them as intervals between bright lines."

"It must be distinctly understood that in speaking of the solar spectrum here, I do not mean the spectrum of any limited area upon the disc or margin of the sun, but the spectrum of ligh from the whole disc. I have not an image of the sun upon the slit of the spectroscope, but have employed the beam reflected from the flat mirror of the heliostat without any condenser."

The discovery may be considered as three-fold: first, that there are bright lines or bands in the solar spectrum; second, that certain of these lines coincide exactly with the known oxygen lines in the spectrum of air produced by the electric spark; and third, that others of them probably coincide with the lines of the metalloids, or may be referable to unknown substances. Hitherto the presence of oxygen has not been discovered in the sun, although its existence might have been suspected there on purely theoretical considerations, based upon terrestial chemistry, the nebular hypothesis, and the fact that that element makes up eight-ninths of the water of the globe, one-third of the crust of the earth, and one-fifth of the air.

Professor Barker, of the University of Pennsylvania, who was present, said that he regarded the discovery as the most important contribution to solar physics made in America, and the most important anywhere since the discoveries of Kirschoff.—*The Polytechnic Review.*

Mechanical Stoking.

A paper was recently read at the Society of Engineers by Mr. J. Walter Pearse, on the "Mechanical Firing of Steam Boilers." The author first pointed out some of the disadvantages of hand-stoking, and observed that so far back as 1813, mechanical firing was proposed.

In 1822 Mr. J. Stanley invented a stoker with crushing rollers a single horizontal fan, to which in 1834 he added rocking fire-bars. In 1838 Mr. Jukes patented his first stoker, and in 1841 he invented the endless chain of fire-bars, modifying it again in 1842. In 1863, Messrs. Wilson and Smith brought out their furnace, in which the fire-bars were made to travel backwards, carrying the fuel from a hopper to the back of the grate, an arrangement which was improved upon by Messrs. Vicars and Smith in 1867. In 1870 Mr. Dilwyn Smith patented his stoker, in which the fuel is fed on to distributing fans revolving horizontally. This arrangement was improved upon, in 1870, by Mr. J. F. Deacon. Further additions were subsequently made by Mr. T. Henderson.

In the Henderson stoker the supply of fuel is effected in the same way as in the Dilwyn Smith machine, but the fire-bars are made to move by simple gear connected with the stoker. Every other bar rises and falls, while the rest slide to and fro, the effect of this action being to clear off the clinker. The Frisbie feeder improved by Mr. J. M. Holmes is for slow combustion and intermittent feed. The coal is thrust up underneath, and in the middle of the fire, so that the gases evolved are consumed on passing through the incandescent mass. This stirs the fire and propels all clinker to the circumference of the circular revolving grate. Mr. Holroyd Smith's "Helix" fire-feeder gives a continuous feed from below by means of a screw working in a casing connected at its upper side with a trough which takes the place of one or two fire-bars.—*Jour. Society of Arts.*

The Mississippi Jetties.—Captain James B. Eads has made a lengthy report to the South Pass Jetty Company, of St. Louis, which covers almost the entire operation at South Pass since the work has begun. The result, as stated by Captain Eads, is as follows: Our works were begun two years ago in an unused outlet of the Mississippi river, and have necesarily distribtued the regimen govering the overflow to the sea by an enormous volume of water; but theories upon which they were based have been fully vindicated by the the results produced, and it is now manifest that entire and complete success will reward our labors. Captain Eads, in his report, claims that across the sand bar at the mouth of the pass the channel is 20 feet deep and 200 feet; wide where previously the depth was 8 feet; that over the shoal at the head of the pass the channel is 20 feet deep and 400 feet wide, where previously it was 14 to 15 feet deep; that for 2.000 feet there is a depth of 28 feet and width of 300 feet; that the Gulf current will prevent any bar forming outside the jetties. He says in conclusion; Finally, I may add with absolute certainty that this entire system of works is now so far completed that no financial difficulties can intervene to arrest the processes of nature which are constantly operating to enlarge and perfect the desired channel through them.—*The Polytechnic Review.*

Electric Illumination at Sea.—The English iron-clad "Alexandria," supposed to be the finest afloat, has an electric lamp attached to its foremost. The *Polytechnic* says the cost of the lamp and the necessary electric apparatus was £1,000, a sum which seems enormous at first, but does not appear so very extravagant when we reflect that it is proposed to protect a ship the insurance of which amounts to £600,000. The electric light serves two purposes, first—as a beacon light to point out dangerous reefs of rock or sand: and second, as a protection against torpedo boats. The light is thrown out from all sides of the lamp, and illuminates such a large surface of the water that it would be almost impossible for a torpedo boat to approach without detection; especially as the light falling upon the smoke would suffer such refraction as to make the boat's existence even more apparent than if the light had but fallen on its surface. This latter function of the electric light is very important, since ships have heretofore found no protection against the attacks of the torpedo boat.—*Mining and Scientific Press, Aug. 18.*

Steel Wire Rope.—Trials of steel wire rope hawser have been made recently at Portsmouth Dockyard with the result of showing that the breaking strain of the steel wire ropes is more than three times that of a hempen hawser. The sizes tested were respectively 7 in, 6 in, and 5½ in. in circumference, and were guaranteed to have a breaking strain of 110 tons, 80 tons, and 67 tons respectively. They broke at 118 tons, 92 tons, and 75 tons, in each case considerably higher than the guaranteed strain, although the ropes actually tested were picked out at random from a number supplied some time since. The core of each rope is formed of tarred hemp, over which are twisted the strands of wire, the strands themselves being made up in some cases of as many as 19 highly-tempered steel wires.—*Eng. Mech.* xxv. 531.

Prices of Gas Coals.

We have no change to note in the prices of the standard gas coals, viz.:

Westmoreland	$5.50	$4.50)	at Baltimore.
Penn	5.50	4.50)	
Despard	5.35		
Marion	5.35		
Murphy Run	5.35		
Newburgh Orrel	5.35		
Ches. and Ohio RR. Caking Coal	5.25		
Block House	4.50	1.75)	Gold f. o. b. at Mines
Glace Bay	4.25	1.60	
International	4.25	1.60)	
Clear Hill	4 00		
Cannelton Cannel	10 00		
Peytona	10.00		

The continuance of the strikes in Pennsylvania and Virginia has prevented receipts of gas coal at tide water from the mines in those States. The only supplies of domestic coal are now coming over the Chesapeake and Ohio Railroad from the Kanawha Valley. The quantity available from that source is at present quite limited, the facilities of the railroad company not being sufficient to meet any extraordinary demand upon them. The difficulties in the Cannel mines of the Kanawha which has caused a cessation of shipment from that quarter since June, have been met by the introduction of mines from Pennsylvania, and it is hoped that no further trouble may be experienced in that section. Cannel supplies are now regularly coming forward to Richmond.

Arrangements has been made with the Pennsylvania Railroad, and Baltimore and Ohio Railroad Company, by which the present freights on gas coal for the New York market, have been extended to March 1st, 1879, thus setting at rest all fears of higher prices next year. Many of the gas companies in New York and vicinity have availed themselves of this management to provide for their supplies for the extended time, at the present prices, which have been considered quite satisfactory.

Receipts of Provincial coal continue at New York and the principal New England ports—prices are nominal at above quotations. Should the discussion of the Fishery question, now going on at Halifax, lead to free coal under a renewal of the Reciprocity Treaty these coals will assume the same prominence they occupied a few years since. Being entirely independent of rail transportation, the coal companies are not hampered in making their prices; the removal of the present duty would admit these coals into New York at less than $4 per ton.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

September 3, 1877.

☞ All communications will receive particular attention

	Capital.	Par.	Bid.	Asked.
Gas. Co.'s of N. Y. City.				
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	95	97
Manhattan	4,000,000	50	205	210
Metropolitan	2,500,000	100	135	140
" Scrip	$1,000,000	..	100	103
" Bonds	500,000	1000	92	94
Mutual	5,000,000	100	96	98
" Bonds, gold.	900,000	1000	105	—
Municipal	1,000,000	100	70	80
New York	4,000,000	100	120	135
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	150	160
Citizens	1,200,000	20	75	80
" Scrip	320,000	1000	95	97½
Peoples	',000,000	10	40	45
" Bonds	$ 325,000	...	...	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	80	85
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	115	120
" Scrip		...	100	103
Union Co. E N. Y.		25	—	50
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L I	25,000	100	...	—
Jersey City	386,000	20	160	165
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	50	85
Lima, Ohi'o	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.		100	100	110
Long Branch	1,200,000	20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	-	20
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	76	—
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	—	95
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97½

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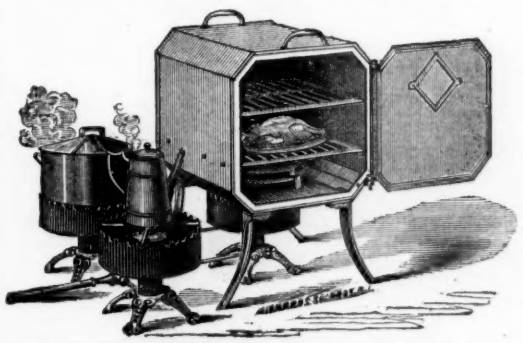

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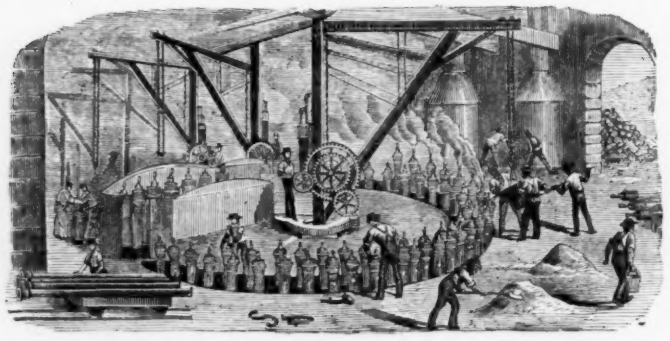

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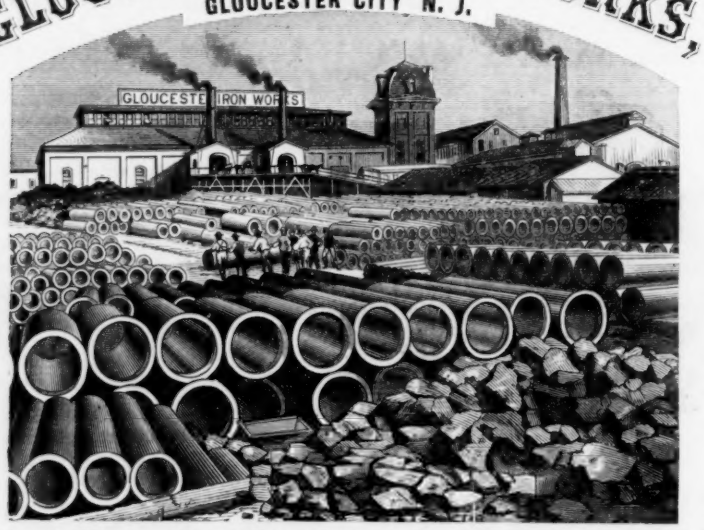

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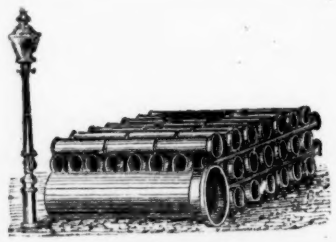

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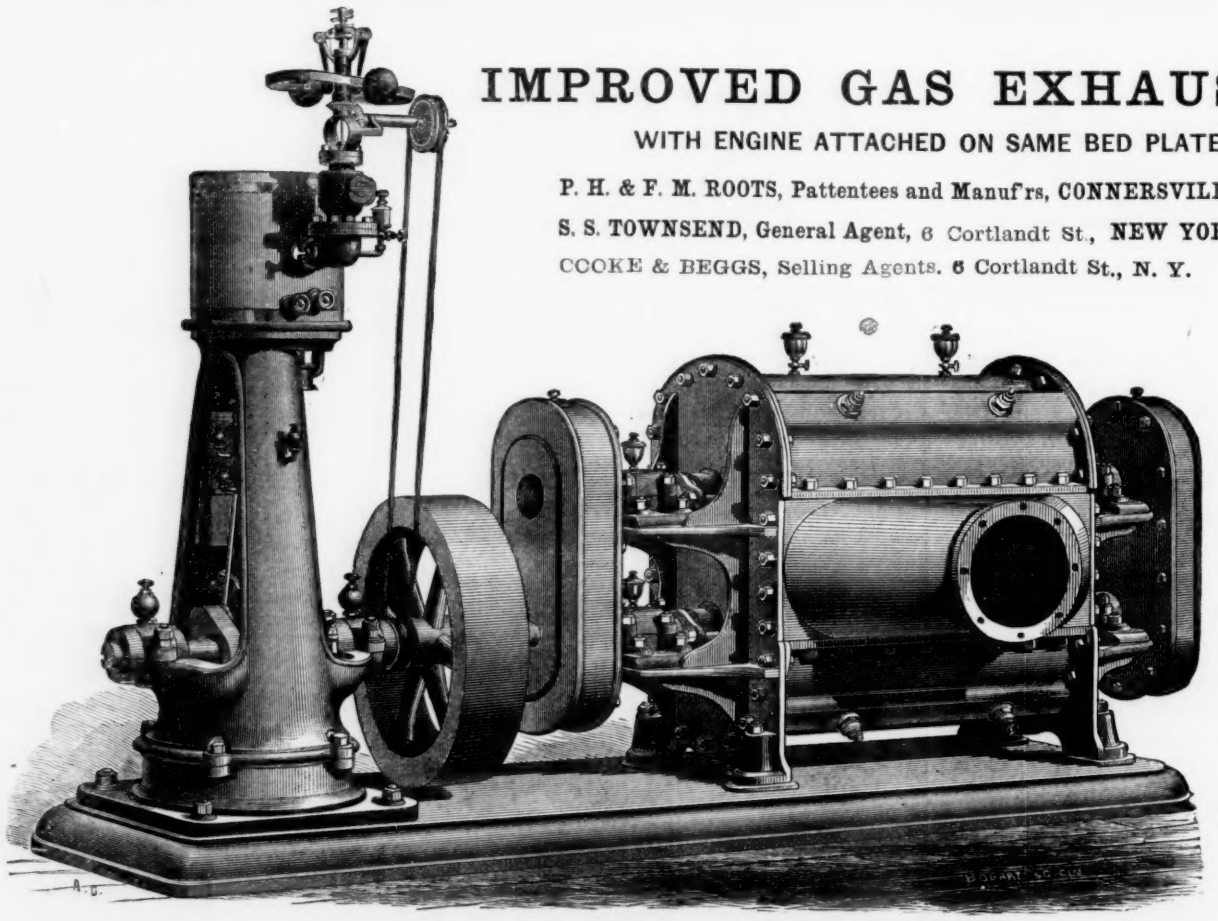

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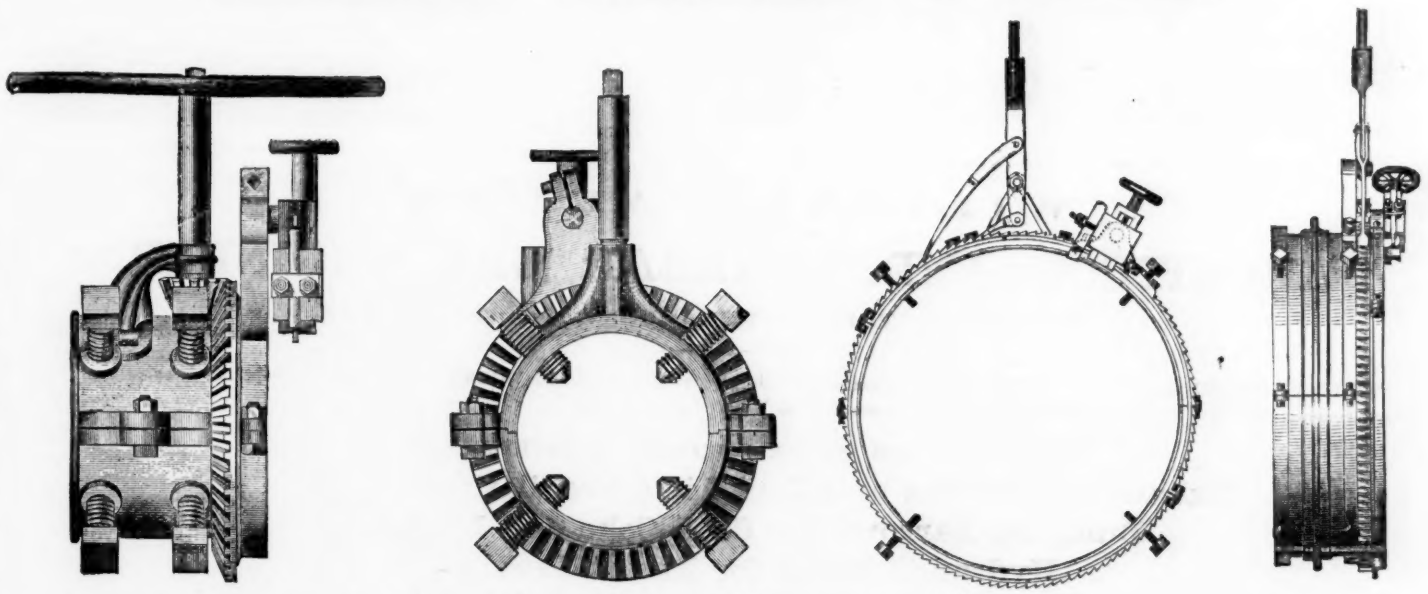

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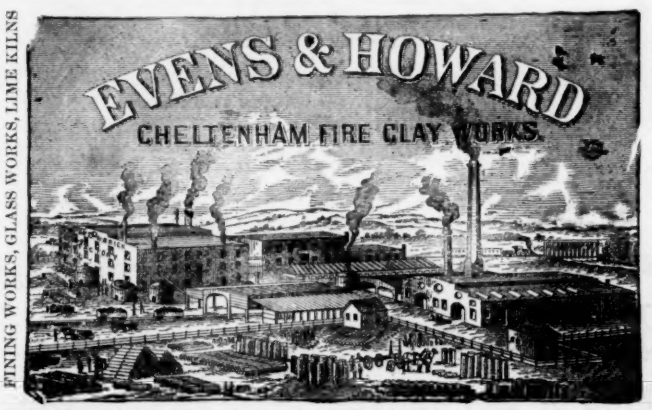

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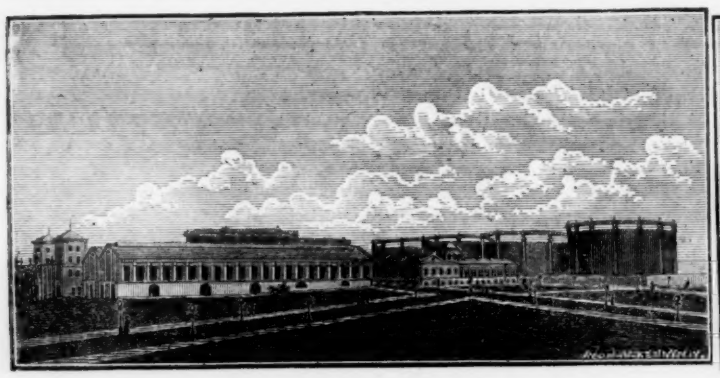

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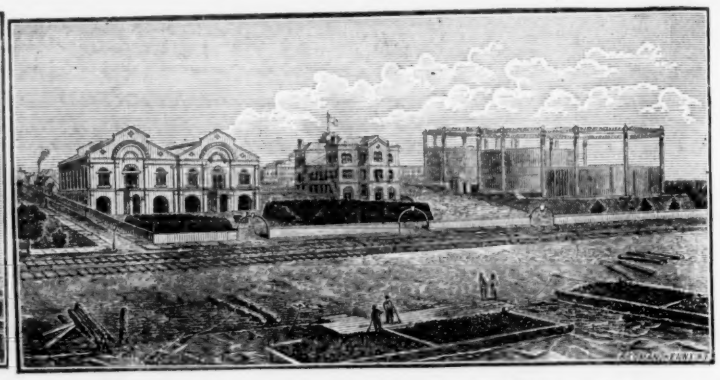

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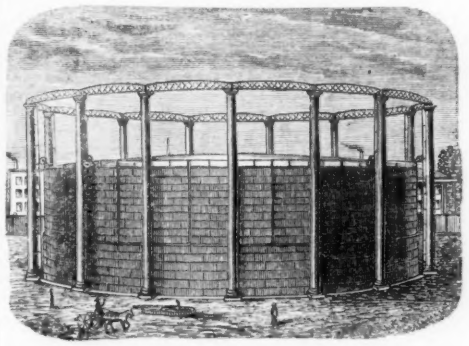

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434—1y

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Attest—J. L. CAMPBELL, Secretary, pro-tem.

Signed—A. T. GOSHORN, Director General

J. R. HAWLEY, President

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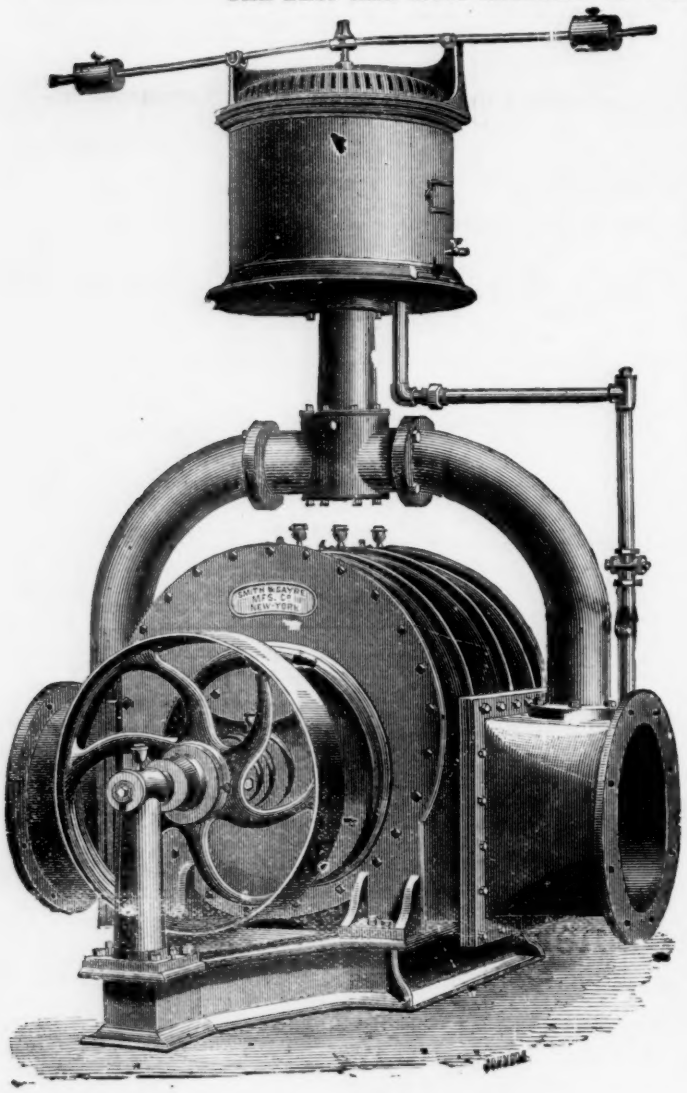

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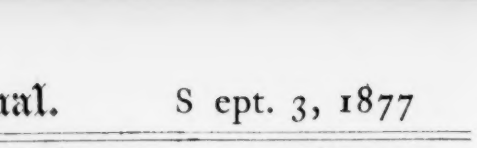

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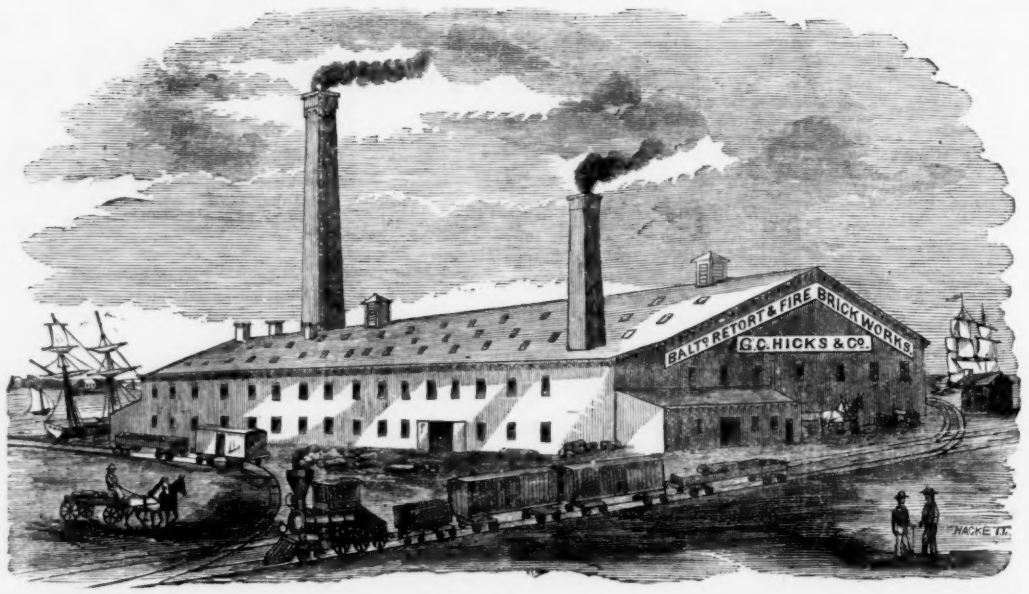

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"GEO. C. HICKS, Esq.,

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"Among the letters which you placed in my hands for examination regarding the general standing of your fire clay, gas retorts, and gas furnace, bricks, &c., there were a number from the leading gas manufacturers of the U. S., speaking in the highest possible terms of their durability, freedom from the accumulation of condensed carbon, and general excellence. I regret that these letters are mislaid, or still remain in the Judges' room at the Centennial. I suppose you are aware that your retorts were awarded a First Premium at the Centennial.

"Yours truly, E. T. COX," *of the Centennial Jury of Awards.*